

# The History of Memes

## Growth of Shared Consciousness

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### Abstract

Humans live in and interact with a complex world that keeps our minds quite busy. In addition to the constant flow of external events, and the flow of our private thoughts, we perceive many internal emotional and physical sensations: smells and tastes, anxiety, hunger, thirst, anger, love, fear, sweating, our own muscle movements, and the passage of time among many others. The term “meme” has grown popular for referring to all that we notice about our conscious world. We commonly share at least some of our perceptions of the world with other people: family and friends, and people in our village, or tribe or city. They share their insights with us in return. These memes tend to change somewhat in every social interchange much as do ideas in our own minds as we revisit them. Yet groups often develop a general consensus, with some disagreement of course. In that way, groups of people create what might be called “group minds”. And, just as individual minds adapt to new circumstances so do group minds.

Each cultural transition enlarged the human meme-pool. As the Ice Age waned, hunter-gatherers who lived in caves moved out into open land and learned to farm and domesticate animals. Then small villages emerged where farmers gathered to trade their produce for that of others. Villages grew into cities in Sumeria and Egypt, bronze weapons promoted warfare that built empires, and writing was developed. Commerce grew via ships and camel caravans. English Spanish and Portuguese ships opened new empires across the Atlantic. Then we began using energy other than muscles (steam, petroleum and electrical), which initiated the Industrial Revolution. Telephones, radio and TV expanded communication. Finally, we invented and exploited computing and then the Internet. Each transition increased the types and number of memes we deal with and the distances over which we collaborated. Writing both increased the longevity of memes and induced new forms of memes; we created poetry, and wrote praises to kings, pharaohs and military conquerors, and we began recording written histories. The styles, shapes and materials used in creating the many objects that we build, use, or wear changed as well. Such changes supported long-lived traditions that when shared more and more widely, are combined into cultures and eventually whole civilizations such as Western Civilization which involve many languages, many geographies and many religions that compete and collaborate with each other.

We argue that the way humanity shares memes is analogous to the way water falls to earth and then makes its way toward the sea guided by complex topographic features of the land. As the land guides the flow of water, the flowing water changes the shape of the land, creating new paths. Memes behave similarly. Adoption of a meme by one person changes that person’s mind, if only slightly. As new memes spread to family, friends, or acquaintances, each is changed thereby too, and they in turn spread the slightly changed meme further. Mankind is creative and constantly shares new ideas. The history of our ideas is fascinating. As they say: “Rome wasn’t built in a day”. Nor was the Babylonian empire in 18<sup>th</sup> century BCE or the Egyptian empire in 15<sup>th</sup> century BCE.

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# 1 Memes and Media in Human Culture

Modern humans – meaning humans with the same range of phenotypes found in humans today – have lived on planet Earth for at least 300,000 years<sup>1</sup> and have used language for, at the very least the past 50,000 years. During that long history humans have fit themselves into a wide range of ecologies and climates that required different means of staying warm in winter, cool in summer, finding foods that are available and healthy in various seasons and, more importantly, avoiding becoming food for predators, or eating foods that poison us. Humans are the only organism on the planet that is adaptable enough to live in virtually every ecology from the Sahara Desert to the Arctic Circle despite the fact that no food substance, whether animal, plant, or mineral (e.g., salt) can be found throughout the world. As groups and cultures we adapt and explore and try things. And share what we learn about the dangerous or pleasurable consequences of those explorations.

What distinguishes “Cave People” of the Ice Age from today’s Internet people is not our interaction with the various local ecologies, as dramatically different as they are, rather it is our interactions with other people. We use language and other media to share the immense set of memes we routinely encounter today. The wide variety of ways we communicate, now including Wikipedia, YouTubes, social media and most recently electronic meetings with Zoom and its competitors.

New memes are initially formed in single human minds, bodies and souls. Some remain there indefinitely, some are quickly forgotten, but many are shared one way or another with other humans – not just random others, but typically those we meet often and talk with. The back and forth interactions and discussions tend to bring people’s thoughts into similar paths even if their conclusions differ. What emerges out of such sharing may best be thought of as “group minds”. And most people other than young children typically participate in multiple group minds. Families with children share a group mind, as do people who frequently meet in town cafes and shops. Cultures or subcultures grow and morph due to social, commercial, or political shared memes among those who share a language, thus cultural group minds change in extremely complicated ways and the changes tend to happen over days or weeks or even years<sup>2</sup>.

Each human mind contains rich and complex webs of many kinds of memes. In addition to verbal or visual memes such as face-recognition, writing, photos or video, there are physical, emotional, social, cultural, moral, and religious memes, and many others we will discuss below. We perceive, learn, remember, forget, imagine, create associations between memes, and reason using them. We also perceive the physical properties of things around us (e.g., their weight, strength, and usefulness), extrapolate physical dynamics (e.g., to drive a car, or predict the path of a baseball or volleyball or soccer ball in order to throw or catch or kick it), evaluate truth (from practical knowledge or logical reasoning), parse and generate language, and imagine and execute voluntary movements, dance, sing, play chess and sports, and deal with many other categories of information that reside in human minds and bodies and in many and wondrous external structures created or modified by us such as art, sculpture, architecture, mechanical devices and even whole cities<sup>3</sup>.

Our souls, the seats of love and awe and spiritual experiences, also grow at their own pace as we interact with others. Our bodies participate in self feedback too – we hear the sounds we make, we see

1 [https://en.wikipedia.org/wiki/Homo\\_sapiens](https://en.wikipedia.org/wiki/Homo_sapiens)

2 Consider the emergence and subsequent maturation of the Web

3 <https://evolutionofcomputing.org/Multicellular/Stigmergy.html>

the movements of our own arms and hands and feel the touch of our hand on our mouths and other places on our body. Infants absorb their initial memes from raw sensory input: nursing at the mother's breast, elimination, and our other internal bodily functions. These sorts of sensations create the first level of associations that later become grounding for conscious awareness. In the first year of life, such percepts are gradually augmented by improving consciousness of touch, hearing, sight, proprioception, balance, and awareness of basic emotional states (hunger, comfort, anger, excitement, pleasure, fear, etc.). By the age of 1 year, many are walking. By the age of two or so, toddlers begin to recognize themselves in a mirror, distinguish self from others, model other people's actions and integrate themselves with their surroundings<sup>4</sup>. As they grow older, they learn to "reason" by traversing their web of memes,<sup>5</sup> attempting to juxtapose one with another in a kind of trial and error manner. As we learn to recognize more and more people, we begin to note that our 'family' is composed of a certain consistent group, and we presumably notice that our village contains multiple families rather than just many individuals.

Children in all cultures must learn thousands of memes as they grow up. Some of the memes are universal: how to manage their inherent biology (pain, hunger, puberty) and how to control and express their emotions. Almost all children share the desire to grow up and be an adult<sup>6</sup>. What "an adult" of each gender means is defined by each culture. Nonetheless, after puberty children are expected to begin acting as adults. That may mean going to college, or getting married and building a household, or beginning a career, or moving into the house of the parents of your betrothed. Females all over the world are expected to have and raise children and males all over the world are expected to protect the family, go out into the world to hunt, farm, do work that requires strength and stamina, and in clashes with other groups protect their family and tribe and if necessary fight for them.

In many ancient cultures, men raided other competing groups and took by force whatever they could, including women. A bit later, when cultures in the Middle East and Southeastern Europe were maturing, armies were formed to contest for territory. Even today, some countries attempt to expand their borders by warfare<sup>7</sup>. However, in modern economies based on capitalism, such "taking" is mostly abstract and is justified by the shorthand belief in 'Capitalism', however defined. The 1987 movie 'Wall Street' where Michael Douglas in the role of Gordon Gekko argued that greed is a clean drive that "captures the essence of the evolutionary spirit. Greed, in all of its forms; greed for life, for money, for love, knowledge has marked the upward surge of mankind." To the extent that such attitudes are preferable to war with nuclear weapons, perhaps it is a necessary way to partially tame the male drive to compete.

We receive memes and in turn convey memes to others in myriad ways. But that conveyance is strongly biased by social groupings. People from different cultures using different languages who live in different parts of the world simply cannot communicate well enough to share most experiences or thoughts with each other. And social groups are based on many factors other than geography, such as *class* (e.g., the American Middle Class or the Indian Shudras, the hereditary laboring class in India), *shared-language* groups (e.g., English, French, Chinese, Spanish, Swahili, and 7000 other languages in use today), and even *civilization level* groups (e.g., the British Empire or Chinese Civilization).

Culturally shared memes separate humans from even the most "intelligent" of animals such as Koko

4 <https://theconversation.com/how-do-children-develop-a-sense-of-self-56118>

5 See Appendix 1 for more detail

6 Exceptions are signs of mental abnormalities such as Attention-deficit/hyperactivity disorder (ADHD)

7 e.g., the June 2020 fighting between India and China, <https://economictimes.indiatimes.com/topic/India-China-war>

the gorilla who learned more than a thousand human sign-language gestures<sup>8</sup>, or African grey parrots that in experimental situations learned to speak and apparently understand to some degree perhaps over two hundred human words<sup>9</sup>. But Koko and the Grey parrots had to be laboriously taught. Young children are explicitly taught as well. But as they grow older children absorb many more memes from the culture that surrounds them. The cultural anthropologist Clifford Geertz describes the situation thus<sup>10</sup>:

“[Since humans lack a full repertoire of instincts upon which to rely, they] were forced to rely more and more heavily on cultural sources – the accumulated fund of significant symbols. Such symbols are thus not mere expressions, instrumentalities, or correlates of our biological, psychological, and social existence; they are prerequisites of it. Without men, no culture, certainly; but equally, and more significantly, without culture, no men.

We are, in sum, incomplete or unfinished animals who complete or finish ourselves through culture -- and not through culture in general but through highly particular forms of it: Dobuan and Javanese, Hopi and Italian, upper-class and lower-class, academic and commercial. Man's great capacity for learning, his plasticity, has often been remarked, but what is even more critical is his extreme dependence upon a certain sort of learning: the attainment of concepts, the apprehension and application of specific systems of symbolic meaning.”

Our minds are filled with a wide variety of memes (see section 2). Many are linguistic but others are pictorial, musical, emotional, spiritual, physical or even culinary. The accumulated collection of mankind's memes is shared among many overlapping yet distinct sets of people; some body-centered physical memes are unique to one person, some are shared only between husband and wife, or within the nuclear family, or extended family, or village, or country, or speakers of a given language.

Asian, African, European, South American and Australian civilizations differ from one another in more fundamental ways than the layman recognizes. Many tribes of people with their own languages and myths are sprinkled throughout all the major geographic areas of the world<sup>11</sup>. One of the most isolated is the Piraha in the Amazon rain forest of Brazil. It's language is the subject of much study because it breaks some of the rules thought to be necessary to any language<sup>12</sup>. Many hundreds of such tribes exist<sup>13</sup>, some still completely isolated from the rest of the world<sup>14</sup>. Nonetheless each has its own set of myths. In America there are dozens of Native American tribes, most of which maintain their own language, religion, and culture; examples include Navajo, Iroquois, Seminole, Cherokee, Shasta, Modoc, Shoshone, and Paiute. Australia has several aboriginal tribes. China has many as well, the Hmong being the best known in the West. Europe has the Basques, Karelians, and Circassians plus at least fifteen others. Africa has hundreds of tribes. The best known are the Masai (over 3,000 years old), Berbers (over 10,000 years old), Sandawe (over 87,000 years old), and the African Pygmies, the Hadza, the Nama, and the San (known colloquially as Bushmen). South American tribes include Mapuche (the most numerous group of Indians in South America who date back at least to 500-600 BCE), Yanomami (over 8,000 years old), Quechua (who predated the Inca), and the Warao (the boat

8 [https://en.wikipedia.org/wiki/Koko\\_\(gorilla\)](https://en.wikipedia.org/wiki/Koko_(gorilla))

9 <https://news.harvard.edu/gazette/story/2013/12/polly-want-a-vocabulary/>

10 Clifford Geertz, *The Interpretation of Cultures*, Chapter 2 © 1973

11 There 7,099 distinct languages spoken around the world according to the 2017 Ethnologue language database. See:<https://www.worldatlas.com/articles/how-many-languages-are-there-in-the-world.html>

12 <https://www.businessinsider.com/brazil-piraha-language-recursion-controversy-linguistics-2016-3>

13 See Wikipedia article describing many of them here: [https://en.wikipedia.org/wiki/List\\_of\\_indigenous\\_peoples](https://en.wikipedia.org/wiki/List_of_indigenous_peoples)

14 i.e., have no contact with outsiders. See *Survival International's* website at: <https://www.survivalinternational.org/>

people of the Orinoco River in Venezuela<sup>15</sup>. And so forth. Most of these tribes maintain their own language and myths, and many of their ancient customs and beliefs.

## **1.1 Memes Colonize Minds**

Evolutionary biologist Richard Dawkins claimed that the evolution of cultures, hence the spread of cultural memes, can be best understood as analogous to the spread of genes<sup>16</sup>. However, memes have very little in common with genes as Appendix 2 of this paper discusses in some detail. Genes are all inherited at conception, their function determined by biochemical mechanisms rather than by our amazingly flexible minds, and genes mutate *extremely slowly* compared to memes. A given gene may mutate a few dozen times per million years. In contrast, we have essentially no memes at birth, but begin learning them by the thousands during childhood and beyond and some newly learned memes might mutate a dozen times in a single day.

We propose that a better analogy for the flow of ideas among humans is hydrology: the study of how water that falls as rain and thereafter flows downhill towards the sea, mixes with water from other valleys and changes state in its travels to the ocean. Rain drops combine into trickles, then puddles, and then creeks, streams and rivers that eventually make their way to the sea or inland lakes only to evaporate and again fall as rain. In this process, water behaves lawfully but in quite complicated ways, being directed by the topography of the land but, in turn, slowly changing that topography by erosion. The complications are not due to any particular complexity of water, but rather to the complexity of the land it flows over. Memes act in similar ways in human minds. An individual's memes affect and in turn are affected by those of other people, perhaps in casual conversations at the local cafe or street corner, or by purposeful debate or conflict with others. We combine events that we become conscious of with other memes already in our minds to create new ideas, or activate old memories, and we often mention them to someone else. That person may combine whatever we pass to them with their own ideas and purposes and pass them on further to family and friends and neighbors.

Cultures influence memes much the way features of the land affect the routes of rivers. For example, if two drops of rain land a few meters apart very near the American continental divide in the Rocky Mountains, one drop may join water that eventually flows into the Colorado River and ends up in the Pacific Ocean while the other drop joins water that flows across the Great Plains into the Missouri River and eventually to the Atlantic Ocean. Analogously, an idea proposed on one side of the British parliament or the American Senate may flow out to affect substantial aspects of culture, whereas if it is proposed on the other side of the political/cultural divide it may suffer an entirely different fate. The Roman and British empires divided allegiances in large parts of the world and the current Christian/Muslim divide does likewise. And the acceptance or rejection of the socialist/communist set of memes polarized most of the world during the "Cold War".

The complexity of today's meme landscape is now roughly the same order of magnitude as the complexity of the landscape of the habitable portions of the Earth's surface<sup>17</sup>. Even 5,000 years ago that was not so. Prior to the development of writing almost all meme communication was person to person. Prior to the invention of steam engines, and then internal combustion engines, most work was done by muscle power alone, although wind powered sailing ships and windmills were exceptions. Prior to the taming of electricity, the speed of remote communication was determined by the speed at

15 <https://www.airpano.com/360video/vr-warao/>

16 [https://en.wikipedia.org/wiki/The\\_Selfish\\_Gene](https://en.wikipedia.org/wiki/The_Selfish_Gene)

17 Which explains the degree to which mankind's activities are now affecting the climate of the entire planet Earth.

which mail could move by horseback. The telegraph, telephone, radio, TV, and finally, the Internet each multiplied the rate of worldwide flow of memes by orders of magnitude. And as the volume of electronic meme interaction grew, we became more aware of various cultural divides in the world. Language divides people, culture divides people, technologies divide people, religious traditions divide people. Consider how an idea about gender roles might be received by a Christian versus a Muslim or between sects within broad religious traditions, for example a Methodist vs. a Catholic, or a Sunni vs. a Shia, not to mention a Hindu vs. a Sikh vs. a Jain, vs. a Buddhist in India, or Bahá'í vs. Massai in Kenya. Gender unites couples in marriage yet for roles other than within marriage, gender divides people too. Subjects discussed within groups of men differ markedly from subjects discussed within groups of women, and parents teach their daughters and sons differently to prepare them for gender-specific adulthood.

The movement of memes from mind to mind is inherently obscure. Many memes move invisibly at the single person level because the “sender” may not even be aware of being observed or listened to, and the state of the receiver’s mind is unknowable by others. In cultures where writing and literacy have become almost universal, we are all exposed to a wide variety of memes from comic books to religious tomes, from advertising to fashion magazines, from political opinion pieces to predictions about who will win the “next big game”. There are so many sources of memes that no one can know what others read, hear or watch. few really know what others read. Casual discussion and back-fence gossip still contributes memes despite the fact that electronic media, especially the Internet and social media, are replacing back fences. But exposure to a meme does not equal reception let alone acceptance. That depends upon the receiver's attention and receptivity. Still, the larger scale effects often become visible and occasionally become momentous. Consider for example the set of memes that coalesced into the beginning of the American Civil War, or the nationalist and racist memes that led to Hitler's initiation of WW-II or Japan’s bombing of Pearl Harbor.

What humans do that differs from all other species is to spread memes to other humans via language. Written language allowed human linguistic memes to live and influence others for thousands of years as do humanly constructed stone artifacts such as cathedrals<sup>18</sup>, stone fortifications such as the Great Wall of China, roads and bridges, music (and musical instruments), art, sculpture, pottery, stone arrow heads, and other stone tools<sup>19</sup>, and burial goods<sup>20</sup>. Paintings or scratchings on cave walls (somewhat like modern emoji) have existed for at least 40,000 years<sup>21</sup>. The earliest known pictographs, a method of writing somewhat similar to hieroglyphics in which pictures are used to convey meaning are about 12,000 years old. The first written scrolls and cuneiform clay tablets are about 5300 years old and the first libraries began in Alexandria, Egypt, a little after 300 BC<sup>22</sup>. Thus for millennia humanity has been accumulating and sharing information in permanent external forms.

The interactions that contribute memes to each of us are not at all uniform. We all encounter people from many groups according to our family, gender, town or city where we live, co-workers, etc. The advent of electronic media such as telegraph, telephones, radio, TV, and the Internet have increasingly made memes available to even wider audiences than printed text. The webs of memes we absorb affect our worldview whether or not they represent “objective truth”. They may be due primarily to biases in

18 <https://www.oldest.org/religion/cathedrals/>

19 Note: animals such as crows use available items e.g., twigs, as tools but they do not keep them for long-term use.

20 Mortuary rituals such as intentionally burying human skeletons decorated with red ochre are very old. Deliberately buried human bones from 100,000 years ago have been found in the Skhul cave at Qafzeh, Israel.

21 See map in <https://www.newscientist.com/article/mg23230990-700-in-search-of-the-very-first-coded-symbols/>

22 <https://www.ancient.eu/article/207/what-happened-to-the-great-library-at-alexandria/>

the worldview of the person who professes them or they may be deliberate lies, fraud, counterfeits, or invitations to immoral or illegal actions. Or they may be just casual opinions, or jokes, or irony, or deliberate fictions, or honest beliefs that nonetheless are false, or be spoken for their dramatic impact rather than to express truth. Nonetheless, no matter the media or the reliability of the author, new memes are constantly modifying our minds.

## 1.2 Language – the Foundation of Group Minds

There is contention about whether language arose once long ago, as a human proto-language<sup>23</sup> then spread and mutated along with the migrating people who populated the world, or arose completely independently multiple times. The former theory is known as monogenesis, and the latter as polygenesis. Bengtson and Ruhlen (1994)<sup>24</sup> assert that: “...despite the generally antipathetic or agnostic stance of most linguists, the case for monogenes is of extant (and attested extinct) languages is quite strong”. When language first arose is also difficult to determine. However, the sophistication of cultural knowledge sharing that language allows is evidenced in many forms:

“...from around 50,000 years ago—the period referred to by archaeologists as the Upper Paleolithic—an unprecedented cultural explosion began to manifest itself in human communities. This resulted in art work, sophisticated jewelry, advanced stone tool technology, evidence of complex ritual systems and social structures, fishing and boat-building, the manufacture of projectile javelins for hunting, and other trappings of a relatively sophisticated material culture. The conclusion was clear: language must have emerged sometime after 200,000 years ago and prior to this cultural ‘big bang’, some 50,000 years ago.”<sup>25</sup>

Bengtson & Ruhlen identified global etymologies of twenty-seven word/concepts that they tentatively traced back to the most recent common ancestor language based on the occurrence of similar sound-and-meaning forms in languages from around the globe. For example the similarities justifying their inclusion of the word/concept ‘who’ are based on cognates in twenty-four language groups covering the entire globe containing hundreds of separate languages.<sup>26</sup> The concept/words they found by their global analyses are all quite basic human concept/words such as: KU(N) ‘who?’, MI(N) ‘what?’, ÷AQ’WA ‘water’, AJA ‘mother, older female relative’, TIK ‘finger; one’, PAL ‘2’, BU(N)KA ‘knee, to bend’, KUNA ‘woman’, MANO ‘man’, MAKO ‘child’, MALIQ’A ‘to suck(le), nurse; breast’, TSUMA ‘hair’, and C`UN(G)A ‘nose; to smell’. It seems that questions are as basic in human speech as *mother*, *child*, and *water*<sup>27</sup>.

Words are powerful. The degree to which even a single word can affect our minds was demonstrated by an old psychology experiment pioneered by Glucksberg, (1962, pg. 4).<sup>28</sup> The experimental subjects are presented with a backdrop of cardboard, a candle, a book of paper matches, and a small box containing tacks. Two groups of 64 subjects were given the task of attaching the candle to the cardboard back panel using only the objects presented, so that the candle can burn properly, but no wax

23 [https://en.wikipedia.org/wiki/Proto-Human\\_language](https://en.wikipedia.org/wiki/Proto-Human_language)

24 Bengtson, John D. and Merritt Ruhlen. 1994. “Global etymologies”. Available from: [jdbengt.net/articles/Global.pdf](http://jdbengt.net/articles/Global.pdf)

25 <https://www.psychologytoday.com/us/blog/language-in-the-mind/201502/how-old-is-language>

26 The groups are: Khoisan, Niger-Congo, Nilo-Saharan, Afro-Asiatic, Indo-European, Uralic, Turkic, Mongolian, Tungus, Korean, Japanese-Ryukyuan, Ainu, Gilyak, Chukchi-Kamchatkan, Eskimo-Aleut, Caucasian, Burushaski, Sino-Tibetan, Na-Dene, Australian, Nahali, Austroasiatic, Austronesian, and Amerind.

27 See YouTube at <https://www.bbc.com/ideas/videos/do-we-think-differently-in-different-languages/p07ry35k>

28 Glucksberg, S. (1962). The Influence of Strength of Drive on Functional Fixedness and Perceptual Recognition. *Journal of Experimental Psychology*, 36-44.

will drip on the table or on the floor. Both groups were given exactly the same physical setup, with the tacks inside the box. But experimenters verbally told one group that they would be presented with a “box of tacks”, a candle, and a book of matches, or they told the subjects that they would be presented with tacks, a candle, and a book of matches, i.e., the only difference was that the word “box” was not spoken; all else was identical. The group where the word “box” was not spoken took an average of 8.8 minutes, whereas the group where the word “box” was spoken took 0.61 minutes, 14.5 times faster.

Different sorts of verbal interchange communicate different kinds of meaning. Back fence gossip typically communicates a sense of community, perhaps a sense of common morality and customs, violation of which is frowned upon. Discussion between friends may range from quite serious to quite frivolous and may shift from one to another topic effortlessly. At formal institutions (churches and colleges) lectures pass along specific content about religion, science, language, or the latest technologies. “Persuasive” speeches may come from business executives, politicians, advertisers, or sales people. Casual chatting is little more than passing the time, like “How ‘bout them cowboys” (an American football team). People listen to recorded or broadcast speech as well: radio, TV, and YouTubes all have their styles. Sports announcers have their own style, and the stereotypical statements increase the enjoyment of their audience. Live songs are speech of a type, and rapping is also a stylistic form of speech. All of the above styles are identifiably different from each other yet most people likely would find it difficult to say just how the various styles differ. Nonetheless, they are clearly treated differently by both the speaker and the listener. Myths are yet another special case. Some cultures have captured their mythology in writing. But for the past fifty thousand years or so, most myths, stories, and healing rituals have been verbally transmitted from one generation to the next<sup>29</sup>. Even today, in the many cultures that lack writing, a person (often called a shaman or the equivalent the local language) has memorized the tribe’s stories and rituals in order to transfer the mythical tales in exact, or nearly exact form to the next generation. In the case of the Navajo Indians of the Southwestern United States, for example, the shaman also creates a precisely memorized sand painting as he tells each story<sup>30</sup>. The painting illustrates the story and it is created anew each time the story is told.

### **1.3 Written Communication in Culture**

Written language, the hallmark of human civilization, didn't just suddenly appear one day. Tens of thousands of years before the first fully developed writing systems, our ancestors scrawled geometric signs across the walls of the caves they sheltered in. The oldest known cave paintings in Europe are over 35,000 years old. Paintings of hunting scenes have been discovered in Sulawesi, Indonesia that are about 43,900 years old<sup>31</sup>. And cave paintings found in South Africa are about 72,000 years old<sup>32</sup>.

Paleoanthropologist and cave art researcher Genevieve von Petzinger has studied and codified European cave paintings.<sup>33</sup> She has found 32 graphic signs, ancient emojis if you will, that were used around the world<sup>34</sup> tens of thousands of years ago. Dr. von Petzinger argues that their geographic and

29 *The Origins of the World’s Mythologies*, by E. J. Michael Witzel, *Oxford University Press, New York, 2012*

30 <https://artsology.com/navajo-sand-painting.php>

31 <https://www.nature.com/articles/s41586-019-1806-y>

32 In the Blombos Caves of South Africa. <http://www.visual-arts-cork.com/prehistoric/blombos-cave-art.htm>

33 <https://www.newscientist.com/article/mg23230990-700-in-search-of-the-very-first-coded-symbols/>

34 See the “Consistent Doodles graphic” in the New Scientist article at <https://www.newscientist.com/article/mg23230990-700-in-search-of-the-very-first-coded-symbols/>

temporal spread suggests that they have some consistent, if unknown, meaning.

The oldest writing was based on the cuneiform alphabet. It began around 3200 BCE in Sumer, Mesopotamia (now part of Iraq). Cuneiform writing consisted of wedge-shaped indentations in clay tablets made with a reed stylus.<sup>35</sup> It was used for some 3000 years to record temple activities, business and trade as well as stories and myths such as the Epic of Gilgamesh<sup>36</sup>. Its use was not limited to serious things. *“Most tablets would fit comfortably in the palm of a hand – like mobile phones today – and were used for only a short time: maybe a few hours or days at school, or a few years for a letter, loan or account. ... Ancient writings offer proof that our ‘modern’ ideas and problems have been experienced by human beings for thousands of years. Through cuneiform we hear the voices not just of kings and their scribes, but children, bankers, merchants, priests and healers – women as well as men. ... It is utterly fascinating to read other people’s letters, especially when they are 4,000 years old and written in such elegant and delicate script.”*<sup>37</sup> Thus surviving cuneiform tablets record portions of the ancient Mesopotamian “group mind” and it looks quite familiar!

Hieroglyphic writing was developed in Egypt about 2400 BCE. Egypt, however, was multicultural and multilingual<sup>38</sup>. Other than the Nile delta near the Mediterranean, the area that was nominally Egypt consisted of little other than the 4000 mile long Nile River valley with its relatively narrow flood-plain that ran through otherwise uninhabitable desert. This long narrow stretch of habitable land was settled by different cultures with quite different languages, several of which had writing: Egyptian hieroglyphs, Greek, Coptic (a Turkik language with written form), and Demotic (another cursive script for the Demotic language). Hieroglyphic writing did not play the wide cultural role that cuneiform did. It was confined to use by the priests and scribes of Egypt. A simplified form of hieroglyphics called Hieratic was used for administrative, literary, scientific and religious texts. Demotic, a Greek word meaning "popular script", was developed in about 350BCE for general use in the daily requirements of the society<sup>39</sup>.

Writing was also developed independently in China in about 2000 BCE, and lowland Mesoamerica by 650 BCE.<sup>40</sup> However all such writing was a laborious hand process not intended for spreading copies of written material to a wider audience until Christianity in the middle ages desired to make the written bible the focus of religious ceremony. The earliest books of the Old Testament are thought to have been put in written form about 1000 BCE<sup>41</sup>. Monastic institutions arose in the early 6th century AD in which monks hand-copied the Latin Vulgate Bible and the commentaries and letters of early Church Fathers for missionary purposes as well as for use within the monastery.

Mechanical printing first appeared in 868 AD when the Chinese began producing printed books from hand-carved wooden blocks. It was a laborious process, so few Chinese outside of the King’s palaces had access to such books. Gutenberg invented movable type in 1449 and the Gutenberg Bible was the first mass produced printed work. Gutenberg’s invention brought mass produced printing to a populace in cities where even some of the middle class could read. The confluence of printing and a higher

35 <https://www.archaeology.org/issues/213-1605/features/4326-cuneiform-the-world-s-oldest-writing>

36 [https://en.wikipedia.org/wiki/Epic\\_of\\_Gilgamesh](https://en.wikipedia.org/wiki/Epic_of_Gilgamesh)

37 <https://www.historyextra.com/period/ancient-egypt/cuneiform-6-things-you-probably-didnt-know-about-the-worlds-oldest-writing-system/>

38 <https://blogs.getty.edu/iris/multilingualism-along-the-nile/>

39 <https://oi.uchicago.edu/research/publications/saoc/saoc-45-thus-wrote-onchsheshonqy-introductory-grammar-demotic>

40 [https://en.wikipedia.org/wiki/History\\_of\\_writing](https://en.wikipedia.org/wiki/History_of_writing)

41 <https://www.livescience.com/8008-bible-possibly-written-centuries-earlier-text-suggests.html>

percentage of literate people allowed knowledge to spread more quickly and widely, which increased the impact of new written memes that altered culture, science, and politics. Newspapers and broadside fliers spread memes widely. The printing press also provided widely available novels, short stories, poetry, text books, encyclopedias, and various translations of the bible. Printing also supported early mass produced consumer items. For example, in 1812 canned foods began to be produced in England wrapped with printed labels to describe their contents.

Samuel Morse invented the telegraph in 1837. It, for the first time, allowed long distance communication of textual messages. By the 1850s, only one state East of the Mississippi had no telegraph offices. In 1854 under-water cables allowed the first rapid communication between continents. That caused widespread social and economic impacts, in part because the United States was so large and relatively sparsely settled that there was need for both business and railroads to send messages rapidly over long distances<sup>42</sup>. Also, the ever innovative economic community discovered remote sales opportunity, “Sears and Roebuck became a very successful company by sending a catalog of all kinds of goods to each telegraph office, so that anyone could place an order over the telegraph wires and have it shipped to them on the railroad. Payment could be wired the same way”<sup>43</sup>. Thus mail order became a much better competitor for local stores. In 1922 the Radio Corporation of America successfully tested printing radio telegraphy via their Chatham, Massachusetts, radio station to the R.M.S. Majestic. Commercial RTTY systems were in active service between San Francisco and Honolulu as early as April 1932 and between San Francisco and New York City by 1934<sup>44</sup>.

## **1.4 Audio and Video Transmission and Recording**

In the last century or two, audio and video communication via different modalities replaced many prior uses of written information. Telephones became available in homes in the 1870s using “party lines” which were shared by several homes in a neighborhood and thus provided little private communication. Instead they tended to provide entertainment and gossip in the neighborhood. In rare cases they were a means of quickly alerting entire neighborhoods about emergencies such as fires<sup>45</sup>. They were a cultural fixture of rural areas for many decades. When private lines became common for everyone in the late 1940s, party-line phones disappeared relatively quickly. Nosy neighbors had to call each other directly, which mimicked back fence gossip.

In the late 1920s, radio began broadcasting news and music across the vast geography of America. The stations out in farm country could be heard for tens or sometimes hundreds of miles in every direction so they brought a cohesiveness that fostered much larger group minds out where people had previously been rather isolated. In the 1930s radio grew dramatically and became a necessary fixture of daily life for many. It provided live news and music and comedy shows featuring joke-tellers and comedy skits<sup>46</sup>. It also broadcast dramas until television took over most of that niche. Radio was also useful for religious speakers, especially on Sunday mornings, so that people in rural areas could avoid long drives to church. That practice continues today and is no longer primarily out in the Great Plains of the US. It is now common in cities, suburbs and in other countries.

42 [https://en.wikipedia.org/wiki/Electrical\\_telegraph](https://en.wikipedia.org/wiki/Electrical_telegraph)

43 <https://www.enotes.com/homework-help/how-did-telegraph-improve-american-life-durin-397282>

44 <https://en.wikipedia.org/wiki/Radioteletype>

45 [https://en.wikipedia.org/wiki/Party\\_line\\_\(telephony\)](https://en.wikipedia.org/wiki/Party_line_(telephony))

46 <https://www.pbs.org/opb/historydetectives/feature/radio-in-the-1930s/>

In the mid 1890s what are now known as “silent movies” appeared. They were black and white films that used subtitles to provide explicit verbal content. Silent-film actors deliberately exaggerated body language and facial expressions to better convey without speech what they were feeling and portraying on screen. Showings of the films were accompanied by live music from a pianist or organist who might play designated music or might improvise to match the film’s content. Occasionally, particularly in large cities, an orchestra would provide scripted live music. Films with full sound began to appear in the 1920s, although the technical difficulties were a big barrier. They needed to develop vacuum-tube amplifiers with enough power to fill a theater, no mean feat itself at that time, and more importantly they needed to figure out how to encode the sound such that it would stay synchronized with the film, again no mean feat.<sup>47</sup> However, the only way people could see films, whether silent or with sound, was to go to a theater, and in the early days, movie theaters were built primarily in urban or in very popular vacation venues where tourists could attend.

Television, thought of at first as just radio with pictures, turned out to have a very different and much larger impact. Encyclopedia Britannica puts it this way:

One aspect of early television that can never be recaptured is the combined sense of astonishment and glamour that greeted the medium during its infancy. At the midpoint of the 20th century, the public was properly agog about being able to see and hear actual events that were happening across town or hundreds of miles away. Relatively few people had sets in their homes, but popular fascination with TV was so pronounced that crowds would gather on the sidewalks in front of stores that displayed a working television set or two. The same thing happened in the typical tavern, where a set behind the bar virtually guaranteed a full house. Sports events that might attract a crowd of 30,000 or 40,000 suddenly, with the addition of TV cameras, had audiences numbering in the millions. By the end of television’s first decade, it was widely believed to have greater influence on American culture than parents, schools, churches, and government—institutions that had been until then the dominant influences on popular conduct. All were superseded by this one cultural juggernaut.

The first television commercial debuted at the height of World War II. Over time, these ads evolved to become pop culture phenomenon, with some funny, others heartwarming, and a select few game-changing<sup>48</sup>. Television created very different group minds according to families favorite channels. Children watched “kid shows” like Howdy Doody, Lassie, The Mickey Mouse Club, and Mister Roger’s Neighborhood. Adults ended to favor “I Love Lucy”, What’s My Line game show, and perhaps The Three Stooges. Thus television, created different group minds by individual shows, or small groups of shows with similar interest. For the first time, the Group Mind of individual families was splintered rather than united by a new media. But not for the last time. Enter the Internet.

## **1.5 The Internet, Smartphones and Social Media**

The Internet Society’s history of the Internet<sup>49</sup> begins: “The Internet has revolutionized the computer and communications world like nothing before. The invention of the telegraph, telephone, radio, and computer set the stage for this unprecedented integration of capabilities.” At that time (in about 1967) computers were rare, very expensive and use primarily for business accounting and research. Various

47 The trick turned out to be to encode sound on the film itself, see: [https://en.wikipedia.org/wiki/Optical\\_sound](https://en.wikipedia.org/wiki/Optical_sound)

48 <https://www.qualitylogoproducts.com/promo-university/history-of-tv-ads.htm>

49 <https://www.internetsociety.org/internet/history-internet/brief-history-internet/>

business branches and research laboratories in widely separate locations needed a way to share their data quickly in order to collaborate more easily. In hindsight, this seems easy to do, but in fact it was not. The communications specialists hit upon the idea of packet switching<sup>50</sup>, meaning that arbitrarily formatted digital data is split into relatively small chunks known as packets containing about 500 bytes of content data, plus routing data, checksums, parity bits and the like *with no constraints whatever* on the format of the data bits. All sorts of real-world content, e.g., text, images, sound, numbers, etc., could be represented by unconstrained patterns of bits. Thus researchers who wanted to share data with others did not need to negotiate about formats. That is still true today.

The Internet itself is now world-wide with massive bandwidth and almost total freedom. Some governments' attempt to censor the Internet for various reasons but the "Dark Web"<sup>51</sup> using random communication paths and encrypted data has resisted all attempts to censor it. Thus the original "freedom" ethic designed into the Internet continues to this day. And the consequences, e.g., Russia hacking the American Presidential Election to favor a person who will do their bidding, have yet to be seriously addressed as of this writing.

One negative consequence of this lack of accountability is that the spread of memes no longer is accompanied by reliable indications of its "credentials," i.e., the identity or possible purposes of the author or publisher. Almost all media prior to the internet gave indications of the quality and the source of the information. Publications, e.g., newspapers, books, libraries of books, movies, radio stations, television stations and TV networks were all businesses that had reasons to want to protect their reputations, hence tended not to lie and obfuscate in their messages. There are always exceptions, and some get away with it for long times, e.g., William Randolph Hearst's newspapers in the late 1800s and for decades in the 1900s. Today, Fox News outlets are similarly loose with the truth. Deliberate dispensers of propaganda, e.g., autocratic leaders of various countries, continually seek to fool people about the veracity and origins of their propaganda. The style, polish, and form that came from publishers using high quality printing presses, or expensive radio and television broadcasting transmitters, used to signify something about the credentials of the author or media. Those niceties can now be mimicked relatively easily by anyone with time on their hands, a computer, and good word processing and image processing software.

Consumers of information (memes) from the Web and Social Media have little other than some sense of the truth (highly fallible as it is) to distinguish truth from outright lies (e.g., fake news), digital cheating and fraud, and all sorts of other disinformation. The Internet/Web has brought out both the best and the worst of humanity, with very little way of distinguishing between them. Even the size of the organization providing your daily diet of Internet Memes is of no use. Google, Facebook, Twitter, Amazon, etc. (all huge companies owned by billionaires) are also guilty of spreading misinformation and of stealing information about what interests their users and selling such data to the highest bidder. Moreover, Google and Facebook largely control the market for digital advertising which allows them to control which advertising gets displayed on news sites. Those two platform monopolists receive the bulk of the revenue from such ads. So legitimate local news organizations are going out of business.

50 [https://computersciencewiki.org/index.php/Packet\\_switching](https://computersciencewiki.org/index.php/Packet_switching)

51 <https://www.csoonline.com/article/3249765/what-is-the-dark-web-how-to-access-it-and-what-youll-find.html>

## 2 Varieties of Memes

The term 'meme' as used in this paper refers not just to oral and written linguistic concepts, i.e, ideas that can be communicated between people. It refers to contents of mind of every sort that can be accessed consciously<sup>52</sup>. In addition to verbal ideas, there are emotions such as love or hate or fear, general mental states like 'sleepy' or 'a little drunk' or 'awe', and intuitive value judgments like "that's a lie" or "he's sexy". There can be no exhaustive list of the aspects of life that qualify as memes; all that is required is that a percept or concept reaches a person's consciousness and gets noticed. Some are internal to our bodies, e.g., hunger or the need to empty one's bladder, some are largely hardwired facial expressions that act as signals between people (e.g., smiles, frowns, looking puzzled or angry), some are aspects of inanimate objects that have been constructed or modified by people for some purpose e.g., the shape of a clay pot or a stone arrow head, or Westminster Cathedral, or a Shinto shrine. And some memes are formed by mandate or consensus by various groups of people from families to civilizations.

Below we discuss examples of memes of more than forty distinct varieties. These different types of meme tend to have different life-cycles, pass from one person to another via different paths, evoke different activities or categories of thought, be more or less easy to describe verbally or to recognize visually, and so forth. The categories are not arbitrary but other categorizations may work just as well. And in different cultures with different languages, different categorizations would undoubtedly be more appropriate.

### 2.1 *Non-verbal Memes*

- How our bodies change with age – In our early teens, each person is surprised by signals of puberty such as female's first menstrual period (at an average of 12 and a half). A male's first conscious ejaculation tends to be on average at a year or so older. Both presage our entry into a new social role that previously was inaccessible. Puberty imparts growth and increased muscle mass to males which gives them new physical skills that require strength and coordination. Females bodies change to attract males and typically increase the desire to pair up with a male and bear children. Both males and females have hormonal changes that increases their interest in the other gender. Many cultures have ceremonial recognition of "coming-of-age" such as the "high school prom" in English or American cultures, or the Bat and Bar Mitzva in Jewish culture, or the Maasai ceremony in Kenya where boys (and sometimes girls) are circumcised.<sup>53</sup> In general, rites of passage in adolescence mark the transition into a sexual world. Later, as we reach "middle age" our hair may begin graying and males may begin losing hair. Eventually both genders lose their fertility. As we become elderly, our memory may become poor and we lose, strength. Since all culture's face such transitions, these "facts of life" are well known whether or not they are commented upon by others.
- Non-verbal signals accompanying social interactions – We all send and receive signals as we interact with others via intonations, gestures, body postures, the pace and rhythm of the communications, and many other subliminal signals that communicate states such as excitement, relaxation, intensity, fear, anger or boredom. Smiles, frowns, and raised eyebrows

52 Aaron Sloman, Phenomenal and Access Consciousness and the "Hard" Problem: A View From the Designer Stance; Semantic Scholar, 2010.

53 Other cultures have much more bizarre initiations, See <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2367147/>

or winks also provide nonverbal feedback in interactions. Such signals can dramatically modify the meaning of the words being spoken (consider irony or humor). Facial signals are the most complex. The face has 43 muscles, the purpose of which is almost entirely to express emotions<sup>54</sup>. As children grow up they learn to “read” the emotional state of other’s faces, and they do so primarily without conscious awareness. Bodily and postural signals are also informative<sup>55</sup>. Crossed legs or crossed arms are signs of resistance. A shrug shows that a person doesn't understand what has been said. Open palms are an ancient display of honesty. When a conversation is going well, the postures and movements of both parties tend to mirror each other. But in most cases, neither party is consciously aware of such signals.

- Recognizable external objects – We recognize a very wide range of animals and plants in our world without effort once we have learned what they look like, sound like, smell like, or perhaps what their texture feels like, even when we do not know names for them. We also recognize affordances – the purposes that things can serve<sup>56</sup> – without conscious effort. One example might be a sizable rock beside a tree that, if we stood on it, would allow us to reach a nice fruit on the tree. Facial recognition is an extreme example; the average person can accurately recognize perhaps 5000 people’s faces including the faces of nameless strangers encountered often during your daily routine<sup>57</sup>. We are also good at interpreting photographic and artistic images, interpreting maps, following roads and trails, and many other percepts from vision, audition, olfaction, proprioception and kinesthesia (awareness of the position of our limbs or the feel of stretching to reach some object or of kicking a ball). We also recognize sensations within our own bodies: movements and other sensations from our lungs or guts, muscular states (tired, strong, sore), and even such usually unnoticed states as the feel of our hair on our forehead, a stuffy nose, a full stomach, being out-of-breath, sweaty, dizzy, anxious, or the jittery feeling of the effects of adrenaline from a scare.
- Ongoing feelings – longing, loving, wishing, praying, fearing, anticipating, avoiding, dreading, desiring, hoping, intuiting, etc. These memes have names, but the reality beneath each of their names is not verbally definable.
- Ongoing actions over time – walking, running, climbing, falling, driving, eating, crying, humming, whistling, washing, showering, or sleeping. We seldom are aware of the details of such behavior. Instead we value each of such activities as a whole.
- The passage of time itself – Our subjective perception of the passage of time is non-verbal and somewhat loosely tied to the physical passage of time. In some mental states, e.g., meditation or prayer, our minds seem to slow down and give us a sense of peace, whereas in exciting circumstances, e.g., when playing a rapid sport such as tennis, our minds seem to run faster. Psychoactive drugs also change perception of time. Stimulants such as caffeine, cocaine and amphetamines produce overestimates of time duration whereas depressants such as alcohol and barbiturates produce underestimates of time duration.<sup>58</sup> Most modern day people seldom pay careful attention to the slower passing of seasons or the apparent movement of the stars. Yet for most of our history, we not only observed the planets and stars to know when to plant and harvest, but also for millennia they took on religious significance. People who live close to

54 <https://www.slideshare.net/DrAyeshaMaxfac/muscles-of-facial-expressions>

55 <https://www.region10.org/r10website/assets/File/17%20Tactics%20For%20Reading%20People.pdf>

56 <https://www.interaction-design.org/literature/topics/affordances>

57 <https://www.sciencemag.org/news/2018/10/average-person-can-recognize-5000-faces>

58 See [https://en.wikipedia.org/wiki/Time\\_perception](https://en.wikipedia.org/wiki/Time_perception)

nature also notice the leaves beginning to change color in autumn, and freshly sprouting leaves and flowers appear in spring. In late summer, fruits ripen, grain fields need harvesting and threshing, and so forth. The winter snows must be dealt with, and in some areas, so must the summer heat. Whole hosts of memes relate to such issues.

- Habits and addictions – snacks, coffee or tea or soft drinks, watching your favorite TV show, or Googling the daily news, tend to capture our attention so subtly that we seem to “discover” that we have succumbed without a conscious decision to do so.
- Nonverbal Cooperative Behavior – Complex rapid and strategic team sports such as volleyball, basketball, baseball, or American or European football require smooth, rapid, cooperative movement among the players. Extensive practice teaches those involved what to anticipate in their efforts and how to respond rapidly and cooperatively without verbal reasoning or communication. Such things have to be learned and perfected by endless practice, coaching, and by pondering experiences from prior games.
- Group social dynamics – Spontaneous standing applause at a performance, or at a sporting event, e.g., a baseball game, when many spectators stand at once and cheer after a batter hits a home run seem to happen without any leadership. Awe inspiring natural events (e.g., a spectacular sunset over the Pacific ocean) may cause dozens of people to stand at the edge of a bluff or cliff over the ocean “sharing” the experience. Nothing may be said, but all are aware that the others are sharing the experience.
- Choreographed Body Movements – Formal body movements and postures carry meaning or have social consequences as well. Examples include: dance (a ballet *pirouette*, or the exaggerated finger movements in Thai Classical Dance), or athletics (a golf swing, a baseball pitcher throwing a curve-ball, a tennis player’s serve). They are non-verbal yet they must be very precise. And it is often remarked that they cannot be done well if one tries to think about them as one does them.

## 2.2 **Verbal Memes**

- People’s given names and nicknames – In every culture and language people’s names evoke a kind of meme magic! A name is more tightly tied to a person than nearly anything else<sup>59</sup>. It usually is the first verbal meme a person learns and thereby teaches them that a particular sound from another person has meaning! So it may be our first lesson about words. In most cultures people have multiple names.<sup>60</sup> The name that others use to refer to them, called the “first name” in western cultures, is typically chosen by the parents. It often is a first name of someone the parents especially liked or respected, or of some hope/desire the parents have for the child<sup>61</sup>. Some people receive a “nickname” early on which is used instead of their given first name. In virtually all cultures, a person’s full name includes the “family” name which is shared by all members of the family<sup>62</sup>. It both indicates ancestry and tells others who know the family that we likely share many memes with others in our family. Thus it is the first indication of our family “group mind”. The child of a farmer tends to know a lot about farming, the child of a cattle rancher knows much about cattle, the son of a blacksmith knows about the forge, etc.

59 See: “In the Traces of our Name: The Influence of Given Names in Life,” Juan Eduardo Tesone, Karnac Books, 2011

60 See [https://en.wikipedia.org/wiki/Personal\\_name](https://en.wikipedia.org/wiki/Personal_name)

61 <https://www.babynames.net/names/>

62 Most cultures are patrilineal, but see: [https://en.wikipedia.org/wiki/List\\_of\\_matrilineal\\_or\\_matrilocal\\_societies](https://en.wikipedia.org/wiki/List_of_matrilineal_or_matrilocal_societies)

Modern-day children learn rather different things from parents, but the principle is the same. We also associate a large number of facts and opinions about people with their name. Personal names become associated with other types of memes a person may be “known for”.

- Named structures and landmarks – Names of places are perhaps nearly as consequential in the long term as names of people because after we know who we are, the next most important fact of life is where we are and where other important places are. Of course there are certain spectacular places we may know of: Gibraltar, the Sahara, Yosemite, Stonehenge, Sigiriya in Sri Lanka, Cenotes in Mexico, the Pyramids of Giza, the Great Wall of China<sup>63</sup>. Local features are named if they are important in day-to-day life: landmarks such as springs or popular fruit trees, river fords or bridges, or in the modern world, local stores, buildings and roads are often named. Within cities, buildings or houses may also have a numeric address to make them easier to find.
- Named Time Periods – Examples include Thursday, Christmas, 4<sup>th</sup> of July, or Sunday (significant in Christianity and other religions). Months approximate the period of the moon, but their names are otherwise arbitrary. Often month names arose in ancient religions: for example, January comes from the Roman god Janus, god of beginnings, and June comes from the Roman god Juno, queen of the gods. Similarly, day names such as Sunday (day of the Sun), Monday (day of the Moon), and Thursday (from the Norse god Thor). Humans need to name days of the week and months of the year in order to discuss when to meet for business or pleasure. The oldest town square clock with bells is in Salisbury, England, built in 1386. It’s chimes allowed people in town to be more punctual. The number of days in a week varies by culture. Several cultures have used a five-day week, including the 10th century Icelandic calendar and the Javanese calendar. The now nearly universal 7 day ‘week’ was initiated in Babylon<sup>64</sup> and adopted by the Hebrews. The Romans later adopted 7 day weeks when they became Christian. An 8 day week was used both in Ancient Rome and possibly in the pre-Christian Celtic calendar. Traces of a 9 day week are found in Baltic languages and in Welsh. The ancient Chinese calendar had a 10 day week, as did the ancient Egyptian calendar. The number of days in a month and months in a year may differ slightly between cultures as well, although months are synchronized more or less loosely on the Lunar cycle. The length of weeks seems to have been related to the “weekly” market day, when people gathered in the nearest town’s market square to sell their produce and buy food for the next week.
- Organizational social structures – it is rare for any social group to lack any structural principle; that sort of thing itself is called anarchy and almost always ends badly, either dissolving or taken over for good or ill by someone with leadership skills. There are structures of laws (at least nominally so) such as congresses and parliaments, structures of people who have power, and somewhat informal structures called classes that are treated differently by the law. Slavery is one extreme of the latter. Legal structures include democracy, socialism, communism, Structures of people include kingdoms or dictatorships. Tribal structures are often a bit of both where customs replace laws, and the tribal chief acts as a focus for decision making. Most of these structures are bounded by some agreed upon geographic lines such as city limits, count lines, and national borders.

63 <https://www.pandotrip.com/top-10-oldest-landmarks-in-the-world-23116/>

64 “The seven-day week originates from the calendar of the Babylonians, which in turn is based on a Sumerian calendar dated to 21st-century B.C. Seven days corresponds to the time it takes for a moon to transition between each phase: full, waning half, new and waxing half. Because the moon cycle is 29.53 days long, the Babylonians would insert one or two days into the final week of each month. From <https://www.livescience.com/45432-days-of-the-week.html>

- Honorific Titles and names for positions – e.g., Mr., Mrs., Sir, Father, General, President, Grand Wizard, Apostle, Saint, Doctor, Speaker, Agriculture Minister, etc. A tribal Shaman or “healer” among the Inuit tribe in Alaska has the title ‘*Angakok*’<sup>65</sup>, the Hmong tribe in Laos and Vietnam call their shaman the ‘*Txiv Neeb*’ (literally, father/master of spirits), in the Voodoo tradition, the high priestess has the title of ‘*Mambo*’. All such titles bespeak long settled cultural traditions and roles.
- Verbal descriptions of emotions – It has been assumed that words for emotional states in various languages describe very similar states. However, “Jackson *et al.* examined nearly 2500 languages to determine the degree of similarity in linguistic networks of 24 emotion terms across cultures. ...There were low levels of similarity, and thus high variability, in the meaning of emotion terms across cultures. Similarity of emotion terms could be predicted on the basis of the geographic proximity of the languages they originate from, their hedonic valence, and the physiological arousal they evoke.”<sup>66</sup>
- Selfness needs and desires – Most living organisms can be thought of as having some degree of “selfness”. Even small insects such as bees, ants, flies, ticks, and mosquitoes exhibit primitive needs such as searching for food. Those who study corvids (ravens, magpies and crows), parrots<sup>67</sup>, elephants, chimpanzees, apes, dolphins and whales find that those species have a strong sense of self and complex needs and desires including social desires to communicate, share with others of their species, and cooperate in dealing with the world.
- Sexual behavior and reproduction – Post puberty, the two genders have separate drives and behaviors driven in large part by hormonal states, but also by social custom and often by different goals ranging from desire for momentary satisfaction of sexual drives to long-term desires for children and family or a partner in life. Throughout historical time, these various drives have combined in complex ways with very different customs and morals. The complexities of gender, sex, and reproduction fill books, articles, theatrical plays, songs, poetry, and many a discussion on the subject.<sup>68</sup> However the roots of gender differences are in our bodies and hormones. The verbal debates about what roles males and females play have cultural effects but cannot change physical realities such as the fact that men’s bodies are larger and stronger, and their minds are more susceptible to aggression and anger whereas women’s bodies can give birth and nurse children and their minds are more nurturing. That is true in all cultures.
- Long-term goals – People tend to have goals for the long-term that, because they are common subjects of conversation tend to have verbal descriptions. Examples include: to fall in love, have a family, obtain farmland, or to build skills suitable for various careers, positions of importance (priest/shaman/tribal chief), adventure (“join the army and see the world”), wealth, knowledge, challenges, peace, contentment, victory and recognition. We also have purposes for the shorter term such as having food on the table, enjoying friendships, or to succeed at the next step of our longer-term goals if we have them. Some people live for the shorter term with desires to fit into the immediate social environment. Some go to college to foster a career, etc.
- Weapons – Clubs, slings, bows and arrows, spears, knives, swords (both bronze and iron), flintlock guns, rifles, dueling pistols, target pistols, automatic and semi-automatic pistols,

65 <https://anthroguide.livejournal.com/6763.html>

66 <https://science.sciencemag.org/content/366/6472/1517>

67 <https://www.audubon.org/news/why-do-parrots-talk>

68 For example: <https://www.ncbi.nlm.nih.gov/books/NBK222297/>, or <https://mitpress.mit.edu/books/sexual-brain>

machine guns, grenades, artillery guns of all sizes, torpedoes and bombs, poison gas (as used in WW-I), etc. All have names because they have always been important for hunting, protection and military uses.

- Flying machines – hot-air balloons, dirigibles, biplanes, WW-I fighters, WW-II fighters (e.g., Messerschmidts, Spitfires, Mustangs, Japanese Zeros, B-1 bombers, passenger prop planes, b-52s, modern fighter jets such as the F-22 Raptor, or MiG-29, or the passenger jets such as the Boeing 747, etc. Then beginning with the German V-2 rockets, ballistic missiles took over the attack role whereas “antimissile” missiles handled the defense. Now small (or large) drones do surveillance missions. And space craft such as the Atlas-5, the Russian Soyuz and the SpaceX Crew Dragon spacecraft using a reusable Falcon 9 rocket, carry astronauts up to the space station.
- Boats and ships – there are Oil tankers, freighters, auto/truck carrier ships, Aircraft Carriers, submarines, fast attack boats, Cruise-ships, pleasure craft, private yachts, houseboats, sail boats of many sizes, Asian “junks”, canoes, outrigger canoes, and many more. The variety of purposes and solutions to those purposes is quite large.
- Ownership – The notion that a person “owns” an object or parcel of land, or a sheep or cow presumably evolved slowly during pre-history. Prior to the agricultural revolution when animals and plants were domesticated, there wasn’t much to own. “Ownership” had to develop before the notion of money because money was a surrogate for ownership of things of value too large or remote to hand to another and say the equivalent of “you now own this”. Linguists have studied the history of ownership and note that linguistic constructions for “possessives” are in all languages<sup>69</sup>.
- Media of Exchange – Money, such as coins, and then paper money are symbolic proof of value and thus act as an intermediary in what was previously barter. Coins were introduced as a method of payment around the 6th or 5th century BCE. Paper bills were first used by the Chinese, who started carrying folding money during the Tang Dynasty (A.D. 618-907) — mostly in the form of privately issued bills of credit or exchange notes. They used paper money for more than 500 years before the practice began to catch on in Europe in the 17th century. Checks are more recent, and credit cards debuted in the early twentieth century. In the last decade or so, it became common to pay with your smartphone. Crypto-currencies such as BitCoin were invented, in part because it was an intriguing idea and in part because it provided anonymity for the parties in the exchange, especially when selling or buying illegal items over the Web. New crypto currencies are still being developed because the basic idea is still evolving. Over 200 new types have appeared just in 2019<sup>70</sup>. The various approaches offer different mixes of difficulty to counterfeit, anonymity, common acceptability, and convenience. The notion of ownership is most abstract in financial market memes – stocks, bonds, bids, asks, futures, interest, NASDAQ, Dow, S&P500, etc. where abstract market instruments are traded, hence ownership is changed or exchanged.
- Fictional characters – Stories told around the campfires and written in fiction contribute tens of thousands of fictional characters with fictional behavior. Yet some, such as Hamlet and other Shakespearean characters have taken on a life of their own and are referenced in conversation as examples for us to follow or avoid. Bilbo or Frodo Baggins, Gandalf, Superman, Mickey

69 <https://www.oxfordscholarship.com/view/10.1093/acprof:oso/9780199660223.001.0001/acprof-9780199660223-chapter-1>

70 <https://bitinfocharts.com/new-cryptocurrencies-2019.html>

Mouse, or James Bond all play similar dual roles. None of them have existed in the real world, but stories about all of them play somewhat the same role as stories about Moses, or Nero, or King Richard I, or Henry VIII of England, or George Washington or Abraham Lincoln. They anchor stories that we can learn from, whether or not they were ever real people.

- Mythical creatures and magic – monsters, dragons and the like, dwarves, gremlins, elves, and other creatures that supposedly can use magic. The accouterments that go along with the creatures are things like magical rings, wands, broomsticks, robes, and hats. The verbal spells tend to be in Latin or other extinct languages, and the spells may possibly rebound on the sender. Belief in (or at least professed belief in) magic has a very long history in which it is often treated as if it were a real art or science.<sup>71</sup>
- Everyday number related concepts – grouping, e.g., a pair, brace or couple (2), a dozen (12) or a baker’s dozen (13), a score (20), or a gross (a dozen dozen, 144). Splitting assets equally, which may imply numerical division is also a common event, inheritance being one case. Units of measurement<sup>72</sup>, e.g., “hands” (4 inches, a measure of a horse’s height at the shoulders), an acre (area), a ton (2000 lbs.), a cord (unit of stacked firewood), a bushel (a unit of volume for grain). And there is also the lay person’s notion of infinity, which is used casually in conversation to mean “an amount larger than we can imagine”.
- Medical, pharmaceutical and nutritional memes – depending upon exact definitions, there are between 79 and 100 organs in the human body<sup>73</sup>. The anatomy and physiology of these organs and their tissues add many more details. All of these “parts” of the body have formal medical names (often in remnants of Latin). Pharmaceuticals have formal names too, and chemical structure diagrams, etc. Folk medicine adds thousands of other beliefs and/or facts about how thousands of other edibles might affect us.
- Business and Academic jargon – Most businesses usually have considerable jargon that is used internally and perhaps by savvy customers, but is not widely known outside those businesses. Academia deals with complex formal principles and topics that are too deep to be expressed simply. Each discipline and topic is the subject of many articles and books that use the specialized vocabularies of that discipline, as do the university courses, e.g., architecture, astronomy, biology, ecology, engineering, law, music, mathematics, medicine, physics, etc. Conceptual memes such as time, gravity, diffraction, drag, lift, turbulence, the role of carbon in life, the stability of iron and uranium, the relationship between mass and energy, the properties of electron shells, quarks, irrational numbers, levels of infinity, prime numbers, genes encoding, epigenetic mechanisms, etc., can only be described precisely with unambiguous symbolic formulas or thousands of words, or both.

## 2.3 *Artistic Creations*

- Paintings from millennia past – Prior to photography all we have in the way of imagery are the thousands of paintings, mosaics, and sculptures done by artists over the millennia. The Chauvet Cave in the Ardèche Departments of France contains the most important preserved cave paintings of the Paleolithic era, painted around 31,000 BCE. The Altamira cave paintings in Spain were done between 14,000 and 12,000 BCE and show bison, among other animals. The

71 [https://en.wikipedia.org/wiki/Renaissance\\_magic](https://en.wikipedia.org/wiki/Renaissance_magic)

72 [https://en.wikipedia.org/wiki/List\\_of\\_obsolete\\_units\\_of\\_measurement](https://en.wikipedia.org/wiki/List_of_obsolete_units_of_measurement)

73 [https://en.wikipedia.org/wiki/List\\_of\\_organs\\_of\\_the\\_human\\_body](https://en.wikipedia.org/wiki/List_of_organs_of_the_human_body)

hall of bulls in Lascaux, Dordogne, France, is one of the best known cave paintings and dates to about 15,000 to 10,000 BCE<sup>74</sup>. There is also Chinese, Japanese, African, Australian, and Native American Indian art from several centuries BCE. There is a painting of Confucius from about 500 BCE<sup>75</sup>. And there are Greek paintings on pottery from a similar age<sup>76</sup>.

- Artful Speech – Prior to the printing press, almost all verbal communication was via the spoken word. Artful speech – poetry, oratory, and rhetoric – were valued as early as 5<sup>th</sup> century BCE in Greece. And persuasive public speeches were the roots of the rise of democracy<sup>77</sup>. Public lectures and performances of oratory or poetry were the primary literary art forms. Thus the artful vocabulary and the precise choices and sounds of the words, both singly and in combination, were appreciated in addition to their explicit meanings.
- Music and song – deserve a special place because they are universal and powerful means of social cohesion. A recent Harvard study<sup>78</sup> “... found that, across societies, music is associated with behaviors such as infant care, healing, dance, and love (among many others, like church ritual, mourning, warfare, and processions). Examining lullabies, healing songs, dance songs, and love songs in particular, they discovered that songs that share behavioral functions tend to have similar musical features.” Sea shanties, for example, were used by sailors on sailing ships to help the teamwork required to raise, lower, or change the sails. Armies drill their soldiers to march and chant in unison, not only to keep them synchronized but also to support group mentality. The verbal content plays some role, but the musical forms, rhythms and tonality are the major value.
- Monuments and public statuary – typically used as memorials for major peoples or events. Major monuments such as the Statue of Liberty and Mt. Rushmore are examples intended to remind people of the status of a nation. In the USA there are statues of famous presidents such as Abraham Lincoln and George Washington. In the UK, there are statues of Oliver Cromwell and King James II, and so forth.

## 2.4 **Religious or Moral Principles**

- Moral Principles – We absorb morals from parents, schools, and religions. They tend to have verbal names and approximate descriptions associated with them even though the underlying purposes are too subtle to be captured in a name. For example adultery is defined differently across cultures. Polygamy is illegal in Western cultures but is legal and relatively common in Kenya, Saudi Arabia, and other parts of Africa and the Middle East. Yet the concept of adultery still applies if the polygamy doesn't follow the local social rules. Activities that are immoral at a personal level may be considered acceptable at large scale. Lying, except under oath or in a document you affix your signature to, or to friends and family, is nominally considered to be immoral at a personal scale, but at scale in commercial settings it is common in advertising and

74 The Chauvet Cave in the [Ardèche Departments of France](#) contains the most important preserved cave paintings of the Paleolithic era, painted around 31,000 BC. The [Altamira](#) cave paintings in Spain were done 14,000 to 12,000 BC and show, among others, [bisons](#). The hall of bulls in [Lascaux](#), Dordogne, France, is one of the best known cave paintings and dates to about 15,000 to 10,000 BC.

75 <https://en.wikipedia.org/wiki/Confucius>

76 <https://study.com/academy/lesson/ancient-greek-art-pottery-sculpture.html>

77 See: [https://en.wikipedia.org/wiki/Athenian\\_democracy](https://en.wikipedia.org/wiki/Athenian_democracy). The crude tweets and phrases of our current president may signal the death of democracy.

78 <https://news.harvard.edu/gazette/story/2019/11/new-harvard-study-establishes-music-is-universal/>

is considered acceptable as the popular phrase “let the buyer beware” attests. Greed is a moral failing at individual levels, but at least in capitalist economies, as the saying goes, “Greed is Good”. “Thou shall not kill” is straightforward and also illegal, except at the scale of war. War itself is not thought of as immoral in large part because the back and forth in the run up to a war is virtually always so complex that both sides can claim it was the fault of the other. And the way nations conscript soldiers somehow takes precedence over individual morality, as does an officer ordering a group of soldiers to attack some target expecting that most or all of them will be killed. With modern medicine, if someone is in horrible pain and near death, relatives could see ending their life as a blessing. And the distinction between theft and borrowing or “misusing” is vague. In general, formal definitions of immorality are somewhat ambiguous.

- Deities and Spirits – Virtually all cultures believe in spiritual entities or states-of-mind that cannot be seen, e.g., gods, spirits, devils, angels, daemons, fairies or sprites invoked as explanations for otherwise mysterious events in the past or desired events in the future<sup>79</sup>. Such spirits are also seen as having independent purpose and agency. According to the *Dictionary of Gods and Goddesses*<sup>80</sup>, thousands of deities are believed to exist by people in one culture or another.
- Beliefs about the Afterlife – Nearly all cultures assume an afterlife of some sort whether it involves a heaven or hell, or nirvana, reincarnation, or some unspecified place from which our ancestors can look down upon us with approval or disapproval. Some African cultures believe that “our ancestors are part of the world of the living, interacting with it regularly”<sup>81</sup>.
- Worshipful behavior – The word “Holy” or its equivalent in other languages and cultures signals that the the subject it modifies is to be treated with special respect because of its religious significance. Often it indicates that some worshipful behavior is needed. Worshipful behavior may include prostrating oneself, performing certain gestures such as crossing oneself, or bowing before religious icons such as a crucifix in Christian cultures. There are equivalents in most other cultures.

## 2.5 Other Types of Meme

- Games – Games are as old as mankind. They are an integral part of all cultures and are one of the oldest forms of structured human social interaction. Yet the notion is almost impossible to define. Games are not necessarily recreational; some have religious or divination connotations, some support gambling, which link into notions of fate and luck. Often they are done to pass the time. Games were played on the “Silk Road<sup>82</sup>” when weather conditions precluded moving camp. Many of the prehistoric games were played with bones, and likely had associations to the afterlife. The ancient game of Tic-Tac-Toe was played at least 3000 years ago. Now people play games against computers. In 2018 there are approximately 2.2 billion gamers in the world. Almost a third of people on this planet play one sort of computer game or another. What does this presage for tomorrow? This phenomena changes so rapidly that no one has any idea.
- Hunting, gathering, and cooking skills – Charred fragments found in 170,000-year-old ashes in a cave in southern Africa contain the earliest roasted root vegetables yet found. The finding

79 Author Bryn Donovan has compiled a list of about 90 examples, see here:

<https://www.bryndonovan.com/2015/09/24/master-list-of-mythical-creatures-and-bengis/>

80 Michael Jordan. *Dictionary of Gods And Goddesses*, Reed Elsevier Inc., 2004

81 <https://en.wikipedia.org/wiki/Afterlife>

82 [https://en.wikipedia.org/wiki/Silk\\_Road](https://en.wikipedia.org/wiki/Silk_Road)

suggest that the real “paleo diet” included roasted vegetables rich in carbohydrates, similar to modern potatoes.<sup>83</sup> “Although the average adult human brain weighs about 1.4 kilograms, only 2 percent of total body weight, it demands 20 percent of our resting metabolic rate”<sup>84</sup>. Larger brains require more calories e.g., from meat and roasted carbohydrate-rich root vegetables<sup>85</sup>. Without roasted foods, species of sapiens with larger brains could not have emerged. Thus knowledge, i.e., memes, about hunting, gathering, making fires, and cooking were vital to early humans.

- Superstitions – Human constructs such as the number 13, and especially Friday the 13th, or gestures such as crossing your fingers, or the number 666 as the “mark of the beast (Satan)” are thought to increase bad luck. An acorn at the window protects the house from lightning. Pointing at a funeral procession will cause you to die within the month, bad luck will follow the spilling of salt unless a pinch is thrown over the left shoulder into the face of the devil waiting there (and many more). While presumably most people do not rationally believe in such superstitions, many act as if they do. For example, the aversion to the number 13 is rampant: more than 80 percent of high-rise buildings lack a 13th floor, many airports have no 13<sup>th</sup> gate, airplanes have no 13<sup>th</sup> aisle, and hospitals and hotels often have no room number 13.
- Uncertainty and Randomness<sup>86</sup> – Complexity causes us to be fallible in predicting events. Complexity creates a sort of pseudo randomness where, we suppose, if we had all the necessary information, we could make perfect predictions. But nothing is completely predictable because the physical world always contains an element, no matter how small, of true randomness which bubbles up from the randomness at the smallest scale where quantum fluctuations are inescapable<sup>87</sup>. Many phenomena in the physical world can exaggerate that randomness at larger scales in certain “edge” cases. Humans often deal with unpredictability in terms of the ‘luck’ meme – the belief that “I am lucky” (or not). “Luck” is related to the notion of “fate” or “destiny”. Most human interactions involve both some randomness and some order. So we tend to evolve strategies and tactics which more or less explicitly recognize unpredictability, yet also prepare for the major forks in possibilities. Examples where the future is more than typically unforeseeable include war (because the ‘enemy’ is being strategic too), hunting (because their prey are unpredictable even though they tend to follow patterns), farming (because the weather is unpredictable from day to day but the seasons are much less so), business decisions (because competitors and customers are unpredictable), and sports (because individual performance on a given day is unpredictable and often some elements of the game itself are unpredictable, e.g., wind, the effect of sun in players eyes, or the bounce of a football).
- Footwear – The first footwear vaguely resembled moccasins. Leather was rapped around straw with room for the foot within and sewn together on the tops with leather thongs. That practice was invented approximately 40,000 years ago<sup>88</sup>. However, it wasn’t until the late Stone Age, e.g., around the time of the Cosquer Cave, that footwear was consistently worn by populations. Prior to that time, people tended to go barefoot. Yet until the early 1800s, there was no difference between left and right shoes.

83 <https://www.newscientist.com/article/2228880-earliest-roasted-root-vegetables-found-in-170000-year-old-cave-dirt/#ixzz69vJD0kER>

84 <https://www.scientificamerican.com/article/thinking-hard-calories/>

85 <https://www.scientificamerican.com/article/cooking-up-bigger-brains/>

86 [https://en.wikipedia.org/wiki/History\\_of\\_randomness](https://en.wikipedia.org/wiki/History_of_randomness)

87 <https://www.scientificamerican.com/article/quantum-physics-may-be-even-spookier-than-you-think/>

88 <https://www.dolitasshoes.com/blogs/news/the-history-and-evolution-of-shoes>

- Clothes and jewelry – Both are usually influenced strongly by gender relationships. Wedding and engagement rings bespeak committed male-female pairing. Engagement rings bespeak betrothal, although usage of that word in the modern world has declined. Females typically wear more jewelry than men: for example, pins, bracelets, necklaces and earrings. Gold jewelry is worn by both genders, but females wear more delicate items, fine chains and the like, whereas males wear much thicker chains. Females often have jewels as well (often imitation costume jewels for practicality), but most males in Western cultures seldom wear any jewels other than perhaps a ring with a diamond. Other jewels such as rubies, sapphires, emeralds and the like are almost exclusively worn by females, often as a sign of the wealth of their husband or the wealth required of any man who might seek to marry them. Clothes are far more complex. At home both genders choose according to weather and personal preferences. At work, especially office work, clothes tend to signal status as much as practical issues. In Western culture, men’s ‘work’ clothes are determined largely by the dictates of their job, e.g., professional men job dress up in suits and men who do manual labor outdoors dress according to the weather. Married women dress according to similar concerns. But single women seeking to marry tend to buy and wear a larger wardrobe, preferably of whatever is the latest style. We are not competent to opine on what any other culture’s women wear, but most unmarried women in most cultures seek to attract a man, hence will pay considerable attention to their dress.
- Dreams – Perhaps the oddest memes of all appear in our dreams! And, although everyone dreams, few people are good at describing their dreams to others. Much has been said and written about the experience of and memory of or inability to remember dreams. But the central fact is that dreams are generated by our minds and are experienced by our “selves,” hence certainly qualify as memes. When we awake, our memories tend to distort them and/or selectively forget them. During their typically short lifetimes they can be influential, and in ancient days, dreams were seen as coming from the gods and having power in themselves.

The above list is necessarily incomplete, in part because our minds deal with many types of things that we take for granted without conscious awareness. Other authors may think of different types of memes or disagree with the above categorizations. And many smaller cultures differ in ways that Western authors such as ourselves cannot hope to understand<sup>89</sup>. That is role of cultural anthropologists who spend months or years in different cultures studying the pool of memes used in that culture. That is not an easy task because they must become proficient in a new and sometimes exceedingly different language as well as understand the ecology in which the people live. And the people in these “primitive” cultures are as complex as those in all other cultures. The cultures they have evolved can be so different that it often takes years for Western anthropologists to understand the role played by various types of face-paintings, tattoos, headdresses, large wooden disks inserted into holes cut into ear-lobes and bottom lips, and the dances and other rituals of various tribes in the world. Such decorations and rituals make social statements, or confer status upon the people involved that can be very difficult to understand..

89 <https://www.thesun.co.uk/news/8716261/photos-colourful-traditions-papua-new-guinea-tribes/>

### 3 How Memes Move Through Minds and Cultures

At any given moment, an individual mind may *consciously* encounter an event that creates a new meme or re-stimulates an existing meme. If the event is communicable and socially noteworthy, the individual may communicate it to one or more other people. "Big events" like wars, revolutions, large storms, the crash of an airliner, or even the opening of a new hit movie, tend to create many new memes in many minds. Thus they are inevitably shared with others. The bigger the event the more new memes will be circulating and the more people will want to talk about them unless the events were so traumatic that people avoid even thinking about them if they can, WW-I,<sup>90</sup>. Even within one family or a small town, noteworthy events constantly happen and most are commented upon. Larger groups tend to create unusual events more frequently, so more discussion occurs. As people discuss unusual events, especially multiple such events, they tend to exercise mankind's ability, or perhaps compulsion, to generalize and thus a word for the general case may emerge. Among those who sense a generality, someone creates, or even borrows, a word for the general case and if it is *memorable* enough a new word enters our lexicon and cements the generalization that led to it. Airliner "skyjacking" is a classic example. That word did not exist prior to the epidemic of airplane hijacking in the 1970s<sup>91</sup>. A much older example is the word "gladiator". The idea apparently originated accidentally at a funeral celebration for a wealthy Roman in 264 BCE<sup>92</sup>. But it became very popular as public entertainment for which the Roman Coliseum was built.

Each meme must independently colonize each mind. To be incorporated into a person's mind, a meme needs to fit into the receiver's existing meme network as a new node or new associations between existing nodes. Exceptions do exist, especially dramatic visuals of first-time events such as the Hindenburg dirigible disaster<sup>93</sup>. Most often, however, a new meme must be adapted slightly to fit into each person's existing network. If there is no suitable place for a new meme to fit in, it simply won't enter and be remembered. We encounter this often with new ideas that are said to be "ahead of their time."

#### 3.1 *The Analogy to Hydrology*

The complex morphing of memes as they move from person to person and group to group, and the equally complex changes a new meme can cause in the person who adopts it, affect the reception of subsequent memes. This positive feedback process underlies both the variety of memes in various peoples minds and the complexity of cultural evolution. The movement of memes bears absolutely no resemblance to the inheritance of genes. Hence the term "memetics" is fundamentally misleading. Those who think about such processes need a more accurate analogy.

This paper proposes that the best alternative is that of hydrology. The science of hydrology deals with positive feedback interactions between flowing water and land. Except for a few very dry deserts, water is nearly everywhere. When water evaporates from oceans, lakes, and wet soil the water vapor rises into the atmosphere. As the vapor rises into colder air, it forms clouds, many of which drift over the land and produce rain. On land, gravity takes over and the rainwater flows downhill, its path

90 For example J.R.R. Tolkein and T.E. Lawrence (Lawrence of Arabia) were forever changed by WW-I, as were many mentally wounded veterans of the Vietnam or Iraq wars. Today the phenomena is called PTSD.

91 <https://www.collinsdictionary.com/us/dictionary/english/skyjacking>

92 [http://www.bbc.co.uk/history/ancient/romans/gladiators\\_01.shtml](http://www.bbc.co.uk/history/ancient/romans/gladiators_01.shtml)

93 [https://en.wikipedia.org/wiki/Hindenburg\\_disaster](https://en.wikipedia.org/wiki/Hindenburg_disaster)

dictated by the shape of the land, initially at centimeter scales. Raindrops merge into rivulets that in turn join and grow into creeks that join larger streams that lead to lakes or rivers. The deep and winding Colorado River thereby created the Grand Canyon. In high mountains water freezes forming glaciers that move very slowly but inexorably, and eventually cut huge valleys even in granite: Yosemite Valley in the California Sierras is a good example. There are many others in the Andes, the Alps, Mt. Kilimanjaro, and the Himalayas. Rivers such as the Nile, the Amazon, the Yangtze, the Danube, the Ganges, the Congo, the Mississippi and the Colorado not only support unique complex ecologies but also transport quite large amounts of water and silt or sand to the oceans. Then the water slowly evaporates to fuel the clouds that produce rain that begins the cycle over again.

Although the movements of water and its interactions with the atmosphere, land, life and other bodies of water are quite complex, they are much easier to understand than the creation, morphing, and movement of ideas among humans that often are invisible.

### **3.2        *Movement of Memes from Mind to Mind***

The content of human minds – webs of memes – is almost entirely learned rather than innate. The relatively small innate portion is due to perceivable aspects of our anatomy and physiology that determine our emotions and our everyday needs or desires for food, elimination of metabolic waste, sex, and so forth. Thus the memes for “hungry” or “sick” or “angry” are encoded with different words in different cultures, but mean much the same no matter the language or culture. Those aspects aside, most of our early web of memes is taught rather than passively learned. Parents, family, and others guide us in forming much of our initial web of memes according to their understanding of the world. Thus children learn some aspects of their culture quite early. This stabilizes every culture, often with attention to carrying on parts of culture that are unique. After all, most people are proud of their culture, especially of its unique aspects. The result is that the differences between cultures are greater, if only in subtle ways than most people assume.

Movement of memes from mind to mind is surpassingly complex. Memes move invisibly at the single person level because the exposure to a meme may come from many aspects of their conscious environment or actions or statements on the part of other individuals and we cannot read minds to know what the receiving individual might be attending to.<sup>94</sup> Back-fence gossip, now available on the Web, e.g. from Twitter, Facebook or other social media, is often a factor. But exposure to a meme does not equal reception let alone acceptance. It depends also upon the receiver's attention and receptivity. But large scale movements of a meme often are clearly visible and occasionally momentous, e.g., the set of memes that lead to Hitler's initiation of WW-II<sup>95</sup>. War in general is a very effective spreader of memes. It exposes large numbers of people to dramatic new situations that are important for them to notice and reason about for their own safety. However war tends to happen at such a large scale that few individuals have a very broad view of what is happening. Conquering armies (Gengis Kahn's, for example, that conquered most of Asia in the 1200's) imposed their worldview and other memes upon the conquered people. Religious movements also deliberately spread their worldviews. For millennia prior to general literacy (and the printing press) memes were spread by religious customs that injected

94 One exception is in formal schools where the teacher's job is to transfer specified memes to the students and tests are administered to judge the effectiveness of that transfer.

95 And are again today being fueled by President Trump's minions.

memes into a substantial proportion of a town's non-literate populace.

Consciousness itself occupies a very special position in the space of memes. We become aware of our consciousness in conjunction with the process of becoming aware of our “self” being separate from others, sometime around the age of 2 years old<sup>96</sup>. Once a child has been taught enough of some portion of a web of memes, further learning can be done by semi-independent exploration and observation of “nearby” memes. If a new meme has enough commonality or associations with already present memes to be understandable, the child may adopt it. However, no one of any age can adopt an exact copy of a mem – that would require mind reading. The links that must be made have to make sense too. A child’s web of memes is necessarily impoverished compared to an adult’s so they are at an increased disadvantage. But the external world is perceived idiosyncratically by each individual mind and in some cases by different cultures. We think of colors as fixed entities but different cultures group, hence name, colors differently, or in some cases not at all.<sup>97</sup>

Receptivity to and interpretation of new memes differ by culture, subculture, religion, language, education level, economic class, and individual. The cultures of Afghanistan, Cambodia, Nepal, Mali, and Yemen, for example, are noted for conservatism of all sorts, including resistance to newness itself. Yet their languages are as rich as others and as they encounter new things they cannot but take some note. Individual differences in adoption of memes may also be due to conflicts with preexisting memes. Consider how differently an artist, a business entrepreneur, an engineer, a scientist, and a church pastor might interpret the Great Sphinx of Giza upon first viewing it. Because of their different backgrounds, their interest is likely drawn to different aspects of such an ancient, significant, and large-scale sculpture.

The “rain” of new memes and the processing of them within individual minds and cohesive group minds such as families and beyond is constantly ongoing. Memes in stigmergy<sup>98</sup> structures such as writing, art, or musical scores resist change indefinitely, but their meaning or interpretation may change. Familiar strong individual memes that are rooted in hard reality, like fire, water, up, down, male, female, don’t change significantly over time, but most memes are not so rigidly grounded. Thus networks of memes of every size are perpetually in flux. Memes in constant flow mix with other memes in constant flow to generate ever changing cultural trends.

Most memes, once absorbed into persistent groups, disappear very slowly if at all. We take for granted the oldest memes: making and using fire e.g., for cooking, protecting against predators, firing pottery, smelting metals from ore, and clearing land. Memes for recognizing edible and dangerous plants and animals persist indefinitely. Memes about sexual mores and the various culture's equivalents of the Ten Commandments (bearing false witness., keeping one's oaths, respecting non-shared property and the like) also persist. The origins of such memes are lost in history, but the memes themselves are not lost until the last member of the host culture dies, and often not even then if written accounts exist in libraries, or on the Web.

Religious memes are nearly always buttressed by the afterlife meme which is almost universal among humans. Cultures that believe in an afterlife commonly treat the dead body specially before burial,

96 <http://www.psychology.emory.edu/cognition/rochat/Rochat5levels.pdf>

97 <https://www.sapiens.org/language/color-perception/>

98 <https://evolutionofcomputing.org/Multicellular/Stigmergy.html>

e.g., by staining bones with red ocher, and/or burying “grave goods” with the body.<sup>99</sup> The reasons for the beginning of those customs are unknown, but they nonetheless became common. The earliest undisputed human burial site dates back 100,000 years: human skeletal remains stained with red ocher were found in the *Qafzeh* and *Es Skhul Caves* in *Israel*<sup>100</sup>. And a variety of grave goods were present at those sites, including the mandible of a wild boar in the arms of one of the skeletons.

### **3.3 Meme Migration Between Cultures**

Population geneticists identify ancient historical population migrations by examining geographic patterns in the prevalence of various genetic DNA sequences. Historians, linguists, anthropologists and archaeologists track migration by noting similarity of memes in long-lasting media such as writing, tools, cave paintings, and perhaps jewelry. Prior to the advent of large-scale literacy, memes tended to flow slowly as genetically or linguistically related groups of people moved from one livable place to another, or as representatives of groups such as ships crews, caravans, or soldiers move about. Memes tended to follow hydrological flows of rivers and shorelines and avoid migrating into inhospitable places, e.g., those without water. So meme flow tends to accompany group migrations which, in turn are strongly biased by availability of water.

Patterns of human interaction are the primary feature in the landscape that influences meme migration. Long-lasting stigmergy structures help anchor much of that interaction. Memes move first within nuclear families (anchored by a shared dwelling, shared memories and vocabularies, utensils and tools and patterns of living), then extended families (anchored often by proximity, shared land, and shared food gathering). The next larger level of social connections is due to shared geography and language. Other families from the same tribe or clan or town live nearby. So memes are relatively easily shared within these groups anchored by shared knowledge of local geography, weather, clothing styles, rituals, shared alliances and enemies. Even whole civilizations and empires share some memes, e.g., “democracy” or “capitalism” or “Emperor”.

Within any group, from nuclear families to civilization-wide collections of people, there are meme subcultures that do not freely share memes outside the group. Individuals keep "secrets" as do families and extended families. In many tribes people receive secret "true" names that are considered magically powerful in themselves and act as credentials of belonging in the tribe. If a person claims to be a member of your tribe yet does not know your ‘secret’ name, they are lying. These names are not spoken outside the tribe. And “in-groups” of all sorts do not share everything with “out-groups”. Crafts and professions often strive to keep some of their techniques private when possible. Medieval stone masons, for example, kept some of their techniques secret to reduce competition, and that practice led to the creation of Masonic Lodges which still have secret rituals and beliefs. Various other disciplines are made impenetrable by jargon, e.g., medicine, various academic subcultures, religious subcultures, musical and artistic subcultures, etc. Corporate subcultures, especially within large corporations often demand that employees, and occasionally customers as well, not convey information outside of the group without "authorization". In the case of national secrets, revealing highly secret information is a serious crime.

99 Von Petzinger, “The First Signs: Unlocking the Mysteries of the World's Oldest Symbols”, Atria Books (2016)  
100 [https://en.wikipedia.org/wiki/Skhul\\_and\\_Qafzeh\\_hominins](https://en.wikipedia.org/wiki/Skhul_and_Qafzeh_hominins)

There are also barriers to the import of unwanted memes. Families protect their children from memes that are considered harmful. Villages, towns, and communities resist memes from “outside” that threaten to disrupt important customs or ways of working or thinking. For example, the “West” beginning in the “Cold War” resisted ideas that were judged to support communism. And there is an ongoing clash of civilizations between “The West”, with its notions of freedom of expressions, and traditional Islamic cultures that resist educating females or impose the death penalty for blasphemy. The whole notion of blasphemy exists in many religions to exclude certain memes thought to be supportive of “irreligious” beliefs.

### **3.4 Authority and “Downward” Flowing Memes**

The notion of authority is a potent meme itself, denoting people or institutions that a cultural group expects to define, preserve and enforce the consensus about what is “true” or best for the group they lead. Authority tends to be hierarchical. In rural areas, tribal elders or small village councils tend to be the next level of authority above parents. When all communication was in real-time via verbal communication, increasingly powerful leaders or autocrats led their subjects from a distance, depended upon various subordinates to enforce their will. The invention of writing, printing, and electronic communication supported more “democratic” authority based on written directives and laws. Thus larger governmental bodies such as Towns, Counties, States, Nations, and perhaps even The United Nations, could develop and play roles of authority via written decrees or laws as appropriate to their powers.

Authority is not reserved just for political governing. Within corporate business entities, authority is delegated downward from the Corporate President; everyone except the President is supposed to do the bidding of their manager, and in public corporations, the President reports to the stockholder elected Board of Directors. In religious bodies authorities are the equivalents of Priests, Bishops, Cardinals, and the Pope in Catholicism and somewhat similar levels in many other religions. In some individualistic religions, authority goes no further than the leader of one church. In Universities, the lowest authority is teaching assistants and goes upward to Associate Professors, to Full Professors, then Department Chairs, and University Presidents. In military organizations the lowest are Corporals, and the chain goes upward to Sergeants, Second and First Lieutenants, Captains, Majors, Lieutenant and full Colonels, and Generals or Admirals. And so forth in various other sorts of hierarchical organizations.

In prehistoric time, children learned the daily aspects of life in the group, whether that group was a single family, a farm growing grain or herding goats or sheep, or even earlier a group of hunter-gatherers living in a cave. Note that each of these sources of food involve non-trivial bodies of knowledge. The women and children who gathered foods had to learn how to identify which plants, trees, fruits, and leaves were edible, which were safe and tasted good enough to eat, and which to avoid. The men who went out on the hunt had to be taught how to move quietly and not be seen by their prey, how to recognize and assess the possible whereabouts of local animals from the marks on the ground left by their feet/hooves, from their droppings, from the signs of what they are eating, and how high they can reach to eat, etc. And hunters also had to know how to avoid predators that may want to eat the hunters (lions, bears, alligators, etc.), or simply to avoid venomous snakes.

The development of writing permanently changed the notion of authority because the death of individuals no longer depleted the body of authoritative knowledge. And modern media and modern

transport dramatically expand the distances over which authorities must exercise their influence. Schools, churches, armies, industries, bureaucracies, and other large organizations must rely upon written laws that define how people should behave in the realm authorized by a given organization. Such agreed upon rules live in documents like the Bible, written laws, multiple hierarchies of courts, corporate memos, even the rules for membership in the Boy or Girl Scouts. Thus the root in the word “authority” is “author”.<sup>101</sup>

Authority, because it is cumulative over time, both stems from and creates consensus. Parents remain the embodiment of authority for their children in the early years of their lives. But as children enter school parental authority and its important teaching role is augmented by school teachers. Television took over some of the civilizing role in the 20<sup>th</sup> century (e.g., the Mr. Rogers Neighborhood<sup>102</sup> TV show for children). In the 21<sup>st</sup> century the Web and social media emerged. Still, no matter how we learn and are taught when young, early learning forms a basis for a large proportion of our civilized behavior.

In summary, the world is ever-changing. New memes are created and are adopted by those on the forefront and some old rules become obsolete. But as rules become “tamed” and adopted by a wider group of people, consensus is created and thereafter (unless a revolution overturns the existing hierarchy) the consensus is supported and spread by various authorities.

Authority is often signaled by visible dress: the crowns and robes of royalty are one example. Others include the robes of judges, and the clearly expensive suits and ties of corporate executives. Hovering assistants also signal authority. And in African tribes, feathers and other decorations are signals of authority. Roles signaled by dress or decorations are not at all a new thing. Tribes all over the world use masks, perhaps face-paint, and special garb to signal that the wearer is playing a specific formal role. For example, in Africa, “The Dan people live in the western part of Côte d’Ivoire (the Ivory Coast) and eastern Liberia and are widely known for the wide variety of masks that are central to their cultural life and social organization. For the Dan a mask is more than just a face covering. The complete mask costume is comprised of a headdress, wide skirt made of palm fiber, and a cloth cape, which completely cover the wearer, hiding his body and validating the myth that the mask is a spirit of the forest, not a human being.”<sup>103</sup> Westerners tend to assume that African masks are merely works of art. But in most African cultures, the mask embodies a spirit that the wearer “puts on” with the mask<sup>104</sup>. And such spirits play the role of cultural authorities.

In most countries, enforcement of authority and law is the role of police at the person-to-person level and judges or juries at the group level. The military tends to be the enforcement mechanisms at the largest group level, especially country-to-country. The military, ship’s crews, and airline crews, i.e., people who play specific roles of authority are often identified by badges or uniforms. Away from their roles, they behave and think pretty much as anyone else. When in the role, they must “play” the role so they tend to believe the set of memes that the role requires. That set may be, and often is, quite different from those in their daily life. In wartime, on the battlefield, many officers are always in their role except perhaps when they are alone with an old friend and thus could “let their hair down.” Similarly, in the family, parents often play their role until their children are asleep each night.

Authorities tend to be “in their role” only when they are “in uniform”. That includes pastors, civilian ship’s officers, hotel doormen, theater ushers and even (perhaps especially) circus clowns! Business

101<https://en.wikipedia.org/wiki/Authority>

102[https://en.wikipedia.org/wiki/Fred\\_Rogers](https://en.wikipedia.org/wiki/Fred_Rogers)

103 <https://africa.uima.uiowa.edu/topic-essays/show/29?start=0>

104 <https://interesting-africa-facts.com/African-Art/African-Masks-Information.html>

suits also play the role of a uniforms in large corporations, so that when dressed for work, people are expected to represent the corporation at least to some degree. Perhaps the best example of this is a policeman who puts on the role by putting on the uniform, and likewise leaves that role (except in rare circumstances) when back in “civvies”. An out-of-uniform policeman can go out for a drink with friends, go to the ball game, etc., without being expected to “play cop” with anyone nearby. Uniforms also signal to others what trust can be put in the a person. Thus even a commercial bus driver would be out of place and perhaps distrusted to drive the bus if the uniform didn’t instill trust in their ability.

When societies are stable, all authorities tend to support each other. But over decades, centuries, or even millennia, some aspects of “the way things are” diverge. One example is the slow transition in England, France and other European countries from rule by royalty to rule by elected authorities. Another is the fall of the Chinese Emperor to be replaced by a “communist” government. Shifts in belief systems have also generated large scale changes in authority. In Europe, the Catholic Church claimed all authority in all areas including theology, religion, politics and what is now known as science. The work of Copernicus in the mid 16<sup>th</sup> century began the separation of science from religion<sup>105</sup>. That separation was consolidated by publication of Newton’s Principia in 1687<sup>106</sup>. The growth of Scientific and technical ways of thinking (memes) was augmented by the Industrial Revolution.

## 4 Human Interaction with the World Evolves

We cannot really know much about how mankind related to the world eons ago. The oldest evidence of how people thought about life is some evidence of how they thought about death. We get some hints from ancient “burial goods” things deliberately buried with the dead. We also get some idea about what they hunted and ate and when mankind tamed fire. The bones of their prey tell us something about what they hunted and ate. We know a bit more about the life of the Ice Age “Cave Men” because of paintings and scratchings they left on the walls of the caves in which they lived.

When the Ice Age receded about 11,000 years ago, people left the protection of their caves, went out into fertile land and began to cultivate grains and domesticate animals. The widespread nature of farming led to the formation of local villages, then mud-walled cities (typically small at first, but they grew), which led to multiple allied cities, e.g., in Sumaria and Egypt, that were destined to grow into “empires”. In parallel, mankind explored and migrated widely, discovered widespread sources of various metal ores, discovered smelting which reduced the ores to raw metals, learned to mix copper and tin into bronze. The discovery of bronze earned a title for the times: ‘The Bronze Age’. Bronze made long-lasting hard and strong artifacts, including swords. The metals were found and mined in very widespread geographies, yet were so valuable that armed soldiers desired to conquer the lands where the metals were found. And mankind learned that its difficult to keep a good army down. Thus armies conquered neighboring cities, creating growing empires. Around the same time, writing was developed in both Sumaria and Egypt to record commerce and allowed rulers (supported by armies) to coordinate widely separated cities within an empire. Large-scale shipping led to exploration of the world and long range empires such as the British Empire which include India, parts of Africa, North America, and the Spanish empire largely in South America. ... And each of these large-scale changes led to whole hosts of new memes for dealing with the major changes in life style from one stage of

105 <https://plato.stanford.edu/entries/copernicus/>

106 [https://en.wikipedia.org/wiki/Scientific\\_Revolution](https://en.wikipedia.org/wiki/Scientific_Revolution)

mankind's cultures to the next.

Most recently, the COVID-19 pandemic, because it follows the widespread adoption of social media and Internet conferencing (e.g., via Zoom), has in a mere 3-4 months begun yet another very large transition toward some new social/cultural change that dramatically reduces the importance of physical distance and co-location. People and their companies had offices where they worked; now a large proportion work "at home". That has dramatically changed home life and owners and builders of office buildings, hence property values in urban areas, and job openings for secretaries and many as yet unforeseen cultural roles.

## **4.1 Fire and Food**

Two of the oldest human advances are controlling fire and cooking food. The oldest unequivocal archaeological evidence of deliberate use of fire dates back 300,000 to 400,000 years. During the Upper Palaeolithic (c.50,000-11,500 BP), many human groups relied increasingly on a mixture of small game and plants, gradually becoming skilled exploiters and manipulators of useful wild plant resources including fruits and seeds.

Modern forms of *Homo sapiens* first appear about 195,000 years ago in south Africa. By 100,000 years ago some populations had migrated into southwest Asia, then spread eastward and northward, over time replacing all other hominids (e.g., Neanderthals). The first humans to occupy Australia arrived about 50,000 years ago and the first to arrive in the Americas came sometime after 20,000 years ago.

About 40,000 years ago, toolkits used by early modern human cultures became markedly more sophisticated. They featured a wider variety of raw materials (bone, antler, shell, wood, ivory) and they contained new implements (such as bone needles) for making tailored clothing, engraving & sculpting, taking of animals using nets, harpoons, fishing hooks, etc. The oldest cave art yet found is an elaborate rock art panel from a limestone cave in Sulawesi, Indonesia, that portrays several part animal part human figures hunting wild pigs and dwarf bovids. This painting has been dated to at least 43.9 thousand years old on the basis of uranium-series analysis.<sup>107</sup> Fine artwork, in the form of decorated tools, beads, ivory carvings of humans and animals, clay figurines, musical instruments, and spectacular cave paintings appeared over the next 20,000 years. They buried their dead as did Neanderthals, but in much more elaborate ways.

## **4.2 Hunter-Gatherer Cave Dwellers in Prehistory**

The Mediterranean ocean is a hydrologic feature that has played a central role in the well-studied Mediterranean Culture which some call the "Cradle of Civilization"<sup>108</sup>. That assertion is an overstatement, as Witzel's study of myths shows, but the Mediterranean certainly played a large part of early mankind's expansion into what Witzel calls the Laurasian spread of mankind.

During the last "Ice Age"<sup>109</sup> which reached its peak some 18,000 years ago before starting to recede about 11,700 years ago, the ice grew to more than 12,000 feet thick over most of Europe and North America, locking away so much water that *worldwide sea levels* dropped 400 feet. The Mediterranean

107 <https://www.nature.com/articles/s41586-019-1806-y>

108 <https://unchronicle.un.org/article/mediterranean-sea-cradle-civilization>

109 <https://www.history.com/topics/pre-history/ice-age>

became an inland sea (the Gibraltar passage was dry land as were both ends of the Red Sea) and the Mediterranean Sea water level was more than 300 feet lower than today. People could walk over what is now the Strait of Gibraltar on the Atlantic side, and from what is now Djibouti to what is now Yemen on the Pacific side. However, the average temperature during the Ice Age was roughly -6 °C (22 °F)<sup>110</sup> whereas the temperature inside caves tends to be about 13.7 °C (55 °F) year round due to heat coming upward from the molten mantle below<sup>111</sup>. So warmth was the major factor in forcing “Ice Age Man” to become “Cave Men”.

The much lower water level allowed people to live in caves whose openings are now under water. One such cave, the Cosquer Cave<sup>112</sup>, in France was above the water level in those days and was occupied by humans for millennia. When the Ice Age ended, the melting ice caused the sea to slowly rise above the cave’s single entrance about 7,600 years ago. It was not rediscovered until 1985. The entrance is now 110 feet underwater and can only be entered by expert divers using Scuba equipment. The entrance tunnel slants upward so that large parts of the cave are above today’s water level. It had been unoccupied and hidden for thousands of years. It contain a wide range of artifacts, such as paintings and scratchings on the walls and items buried with the dead that are evidence of the sorts of memes the group dealt with<sup>113</sup>.

Cosquer's parietal art<sup>114</sup> consists of 177 engraved and painted animal figures belonging to 11 different species. It features horses (63), bison and aurochs (24), ibex (28), red deer (15), chamois (4), megaloceros deer (2), saiga antelope (1), and felines (1), as well as a number of highly unusual images of marine life, such as seals (9), fish (4), auks (3), jellyfish, penguins and squid. A further 20 animal figures are unclear and 3 are combinations of different creatures. In addition, there is one anthropomorphic figure of a human figure with a seal's head. The majority of the animals are depicted in the form of rock engravings, with less than a third actually painted. Although quite a few drawings of fish have been found in different caves, the Cosquer images of seals are extremely rare in Stone Age art, the only other known examples being in La Pileta Cave and Nerja Cave in Andalusia, Spain.

Clearly the Mediterranean supported rich cultures of Ice Age people whose art shows that they had relatively advanced techniques for hunting and fishing. The appearance of scratchings/paintings of fish and seals in the cave art fits with evidence for open water travel in the Mediterranean, ca. 11, 000 BCE<sup>115</sup>. They knew a lot about various animals and plants, and about the use of fire for cooking and heating their living space. All those memes would continue to be useful as the Ice Age ended.

Cave art tells an additional story about how the people used their spare time. As Genivieve Petzinger points out, art is one avenue of expression for a group mind. “Once you can store information outside of an individual, think about what the potential is to be able to pass that information onto larger groups of people and to preserve important information,” von Petzinger says<sup>116</sup>. In addition to art, she found 32 abstract symbols that appear in different caves across Europe. She asserts that these symbols must have some agreed upon meaning to be found at such widely separated locations over a 30,000-year time span. If so, both the cave art and the symbols shared over much of the Mediterranean were evidence of shared culture, hence group minds of hunter-gatherer groups prior to the end of the Ice

110[https://en.wikipedia.org/wiki/Ice\\_age](https://en.wikipedia.org/wiki/Ice_age)

111<https://scholarcommons.usf.edu/cgi/viewcontent.cgi?article=1928&context=ijs>

112<http://rioucalanquesalbert.weebly.com/cosquer-cave.html>

113<http://www.visual-arts-cork.com/prehistoric/cosquer-cave-paintings.htm>

114<http://www.visual-arts-cork.com/prehistoric/parietal-art.htm>

115[https://www.brown.edu/Departments/Joukowsky\\_Institute/courses/maritimearchaeology11/files/18306900.pdf](https://www.brown.edu/Departments/Joukowsky_Institute/courses/maritimearchaeology11/files/18306900.pdf)

116<https://ideas.ted.com/what-the-mysterious-symbols-made-by-early-humans-can-teach-us-about-how-we-evolved/>

Age.

Yet they did not know how to domesticate animals, e.g., goats or horses or dogs, or how to plant grains. They were experienced in how to live in a social group and to follow an alpha male and/or a wise woman, but had no experience of group dynamics in larger groups. Memes for those types of skills did not appear until the evolution of cities after the agricultural revolution allowed by the Ice Receding.

### **4.3 Myths – the Oldest Organized Sets of Memes**

Myths originated in pre-history as verbal stories transmitted from one generation to the next. Michael Witzel is a Harvard Professor of Sanskrit, a Philologist, and a comparative mythologist who's recent book<sup>117</sup> examines huge swaths of cultures in terms of their myths. Witzel points out that our natural tendency is to look at myths in each culture as if each myth were developed independently. That approach misses the fact that language differences aside, all of the world's myths are in one of two groups that he calls the Laurasian (Eurasia and the Americas) and the Gondwana (Sub-Saharan Africa, Melanesia and Australia) mythological groups.

The Laurasian Group spread from Northern Africa, i.e., north of the Sahara desert, to India, Europe, Asia, then over the Bering Sea when ocean levels allowed people to move over land from East Asia to what is now Alaska. Those people spread all the way to the tip of South America more than 10,000 years ago. The Gondwana Group of Myths were collectively developed in Sub-Sahara Africa. Each of the groups tell a connected story of the origins of man, however the stories from the two groups diverge. Witzel further posits that an even older and less coherent common myth of all mankind preceded, and contributed to both Laurasia and Gondwana mythologies which were both confined to Africa at that time.

Here is how he explains his assertions:<sup>118</sup>

The complex course of investigations begins with the contents of the various Laurasian mythologies and, more importantly, their unique narrative structure. They share a common story line that tells of the creation, in mythic time, of the world, of several generations of deities during four or five ages, of the creation and fall of humans, and finally of an end of the universe, sometimes coupled with the hope for a new world.

The reconstruction and analysis of Laurasian mythology is counterchecked by a survey of the 'southern' mythologies (of Gondwana Land). They differ in some crucial aspects, such as in missing an account of the original creation of the earth. More importantly, they do not have a comprehensive story line such as the Laurasian one. The results of these investigations are closely mirrored by those of archaeology including early Upper Paleolithic art, of comparative linguistics and human population genetics. They all point to the origin of anatomically modern humans in Africa and their subsequent spread along the shores of the Indian Ocean, up to Australia and southern China, around 65,000 BCE.

Indeed, some of their early mythology is preserved in sub-Saharan Africa and along the path of migration: in the Andaman Islands, Melanesia, and Australia. Laurasian mythology developed somewhere along the emigration path, probably in southwest Asia around 40,000 BCE.

Further, a comparison of both the Laurasian and Gondwana mythologies allows distinguishing

117 Origins and Dispersal Of Our First Mythologies, by Prof Michael Witzel, Harvard, Dec. 2012).

118<https://www.laurasianacademy.com/ORIGINS.htm>

some common features shared by all mythologies (of the globe, 'Pan-Gaia'). They are likely to have been included amongst the myths told by the communities of the African Eve. Therefore, they represent the earliest testimony available of the spiritual world of our ultimate ancestors, something that cannot be accessed in any detail by the other sciences mentioned."

Witzel's conclusions from careful study of hundreds of myths fits with what anthropologists find and with what genetic analysis finds about the spread of hominids over the world. The more subtle point he makes is that the whole body of myths is a unit that, mutations aside, has survived for tens of thousands of years, i.e., many hundreds of generations!

#### **4.4 The Agricultural Revolution**

The Agricultural Revolution (also known as the Neolithic Period) began about 12,500 years ago. As the ice receded to the North, mankind's style of life slowly changed from hunting and gathering to farming domesticated grains and raising domesticated animals. In the Fertile Crescent, bounded on the West by the Mediterranean Sea and on the East by the Persian Gulf, grains such as wheat and barley began to grow in the wild as the climate warmed. People began cultivating such grains, breeding animals for food, and building dwellings near the fields<sup>119</sup>.

The grains that began growing wild were ideal, as it turned out, for domestication by people in the Fertile Crescent where there were mile after mile of relatively flat land. Wheat was domesticated at least 12,000 years ago beginning from a still-living ancestor plant known as emmer. Rice grew wild in Yangtse river basin sites at least 9400 years ago. Domesticated *japonica* rice has been identified by archaeologists at such sites as TongZian LuoJiaJiao (from 7100 BP) and Hemuda (from 7000 BP). And undisputed domesticated maize cobs (corn) were found in the Guila Naquitz cave in Guerrero, Mexico, dated about 6280-6210 BP.

Perhaps the earliest domesticated animals were dogs. The first dogs originated from Asian wolves at least 12,500 years ago. Milk-producing mammals became an important part of early agriculture as well. Goats were among the earliest domesticated animals. They descended from wild forms about 10,000 to 11,000 years ago. Cattle were domesticated in the eastern Sahara no later than 9,000 years ago. Pigs were domesticated 9,000-10,000 years ago in eastern Anatolia and central China and early farmers in both regions took their pigs with them as they spread out from their early farming regions. Domesticated horses and chickens appeared considerably later; horses were first tamed between 5500 and 5000 BP, and chickens were first tamed about 5900 BP in Iran.

Farming and dealing with domesticated animals is very different from hunting and gathering food and firewood. Agriculture differs in so many ways that one wonders what portions of the "Cave Man" culture's memes would have been very useful in the new agricultural world. For example, even the simplest rhythms of life are almost completely opposite from one another. Cave Man lived largely day to day whereas Agricultural Man had to plan months in advance to harvest in the Fall, then save seeds for planting in the Spring, perhaps ration food in the Winter, and plant at the right time so that the seedlings won't be killed by a frost. They also had to understand the various animal's life cycles, know when to slaughter them, when to breed them (if they were managing that rather than just letting them do it on their own), what to feed them, gather eggs, plow the fields (with a horse or ox pulling the plow), etc. They also had to go to market to barter their excesses and get foods from others on market day, riding or walking into town to do so. And so forth. It was a very different lifestyle from Cave life.

119 <https://www.thoughtco.com/animal-and-plant-domestication-4133501>

Undoubtedly it took decades or even centuries for all the “know how” memes to be discovered and passed around. Isolated farms also needed large families and/or extended families to manage all the manual labor. So culture changed in ways that would have been completely unrecognizable to Cave Men.

“...as Neolithic farming settlements gained control of their food supply and became less vulnerable to predators, several things happened. First, the population expanded significantly: from 8 million to 65 million within 5,000 years. Second, communities became more aware and more protective of their ‘territory’. They frequently merged with others, creating larger settlements and (ultimately) cities. Thirdly, they became more organized and more hierarchical. Lastly, Neolithic man began to develop systems of belief in supernatural deities. Each of these social developments had an impact on the art of the period.<sup>120</sup>”

Artists needed to satisfy practical needs as well as create statuary. Highly decorated ceramic pottery became an art form as did ornamental and portable carvings.

“As Neolithic settlements grew in size so did the need for rules and social norms. This led to, or coincided with, the development of religious belief systems and the worship of deities. This in turn led to the gradual emergence of monumental religious architecture for shrines and tombs, which evolved alongside the religious beliefs that it celebrated. The most famous examples of such works are the Egyptian Pyramids (c.2650-1800 BCE).<sup>121</sup>”

The preeminence of agriculture, hence the importance of land, initiated memes to do with the notion of owning land. An idea that was meaningless in the Ice Age (other than being proprietary about the cave and its close surrounds). The harvesting and storage of a years worth of grain also forced the people to invent ways to preserve that grain and protect it from rain. And the economic behavior surrounding “market day” forced new notions of the relative worth of various items bartered in the markets.

Most importantly, for the first time, they needed to predict the seasons accurately. For millennia the Stone Age people had watched the heavens, in large part because of their presumed belief that the planets and stars held religious significance. However, agriculture required care because mistakes could damage a year’s worth of grain crop if one planted too early or harvested too late. The rise of the spring constellations, like Virgo, would mark the time for planting crops whereas constellations like Orion would mark the time to harvest crops before the winter.

Yet all was not peaceful. There was Neolithic warfare too. Neolithic skeletons found in the Talheim death pit<sup>122</sup> suggests that prehistoric men were prepared to brutally fight and kill each other in order to capture women<sup>123</sup>. The hunters from “Cave Man” days had good weapons and were quite familiar with killing. And nothing in the transition to agriculture necessarily produced “civilizing” memes. Those had to wait until the next phase of human culture – cities.

## **4.5 Building Cities out of Mud, Brick and Stone**

One of the oldest continuously occupied cities in the world is Jericho<sup>124</sup>, just north of the Dead Sea and

120 <http://www.visual-arts-cork.com/prehistoric/neolithic-art.htm>

121 <http://www.visual-arts-cork.com/ancient-art/egyptian-pyramids-architecture.htm>

122 [https://en.wikipedia.org/wiki/Talheim\\_Death\\_Pit](https://en.wikipedia.org/wiki/Talheim_Death_Pit)

123 [https://en.wikipedia.org/wiki/Prehistoric\\_warfare](https://en.wikipedia.org/wiki/Prehistoric_warfare)

124 <https://www.britannica.com/place/Jericho-West-Bank>

west of the Jordan River. Jericho is a natural oasis in the desert. Archaeologists have unearthed the remains of more than 20 successive settlements in Jericho, the first of which dates back to 9000 BCE<sup>125</sup> – the early Neolithic era. These early settlers built homes, grew plants, kept animals, and were among the earliest “city dwellers” in the world. Archaeologists found remains of a very large settlement of circular homes dated 8500-7000 B.C.E made with mud brick and topped with domed roofs.

Jericho is one of the oldest of the world’s cities so it has been studied carefully by archaeologists. In large part its location was attractive because springs provided water continuously; an attractive feature in a dry land. A prior culture, called Natufians had founded a settlement there so Jericho may therefore be the longest continuously inhabited urban area on Earth. The Natufians had a sedentary or semi-sedentary population even before the introduction of agriculture thus their culture had aspects of both Cave Dwellers and agriculturalists. They grew cereal grains found in the wild and may even have domesticated dogs<sup>126</sup>. Natufians also had seven other settlements in the Levant and two in what is now Syria. So they presumably contributed memes to the settlers of Jericho common to their anomalous status.

A “city” can be defined as a permanent densely settled place with administratively defined boundaries whose members work primarily on non-agricultural tasks. Its people commonly live together for a common purpose, e.g., protection from outsider predation which, in the case of Jericho, included a stone wall around the city made famous by the Old Testament description (in Joshua 6). They most likely created rules to live by to get along with each other. This led to civilization, which means ‘*to live in a city*’<sup>127</sup>. Such a society must share many memes that were not at all common previously. First and foremost, the notion of rules or “laws” that everyone is expected to obey. The “law” meme creates many supporting memes as well. Some sort of “government” meme underlies the creation of such laws. And perhaps an “authority” meme underlies the enforcement of laws by providing an agreed upon way for the top authority to delegate authority to others who act in “policing” roles.

Farming technology first introduced to the region during the neolithic was adopted widely in Southeastern Europe and advance further by the Vinča culture, fueling a population boom and producing some of the largest settlements in prehistoric Europe. These settlements maintained a high degree of cultural uniformity through the long-distance exchange of ritual items, but were probably not politically unified<sup>128</sup>. Although not conventionally considered part of the "Copper Age", the Vinča culture provides the earliest known example of copper metallurgy. It likely was not at all obvious at the time, but the eventual mastery of metals begun by the Vinča culture was one of mankind’s signature achievements, along with the control of fire which, of course, was crucial to smelting metals.

## **4.6 Mastering Long Distances – Ships and Caravans**

Cities and empires require transport of people and goods over distance far longer than prior modes of living. Horses were domesticated and were useful for riding around the farm or going to town. A horse or mule drawn wagon can bring in the harvest or go to market and bring back foods or seeds. But for longer distances or with heavier loads, people turned to ships or camel caravans.

Ships – In the Mediterranean or on the Nile river, became the primary way to move more than a small

125 <https://en.wikipedia.org/wiki/Jericho>

126 [https://en.wikipedia.org/wiki/Natufian\\_culture#Material\\_culture](https://en.wikipedia.org/wiki/Natufian_culture#Material_culture)

127 <https://www.penfield.edu/webpages/jgiotto/onlinetextbook.cfm?subpage=1525826>

128 [https://en.wikipedia.org/wiki/Vin%C4%8Da\\_culture](https://en.wikipedia.org/wiki/Vin%C4%8Da_culture)

group farther than a day or two walk. Small reed boats were made even in the days of the Cosquer cave. Because Egypt consisted primarily of the long Nile River valley, boats were a natural means of transport there. Thus boats inexorably grew larger to carry more people and goods<sup>129</sup>, and began using sails in addition to oars. The Romans used boats, e.g., triremes, to carry troops to fight and cow the Mediterranean peoples. The British later mastered sailing the Atlantic and around the Horn of Africa to manage their Empire.

Dromedary camel domestication<sup>130</sup> occurred prior to the mid-third millennium bce. The University of Veterinary Medicine – Vienna, writes: "Certain physiological adaptations present in Arabian camels stand out: 1) two sets of eyelashes, better protecting their eyes from the desert sun and wind-blown sand; 2) large, occludable nostrils, giving them the ability to keep inhaled air warm and moist, and to extract moisture from their breath as they exhale; 3) highly-concentrated urine, minimized water loss during urination; 4) the ability to excrete high concentrations of salt during urination, making it possible for them to drink highly salinated desert water unfit for humans or other animals; 5) a highly-refined system of regulating its body temperature, allowing it to withstand the fierce desert heat without sweating; 6) a system of water storage distributed throughout its body and not concentrated in just one or a few places, enabling it to store vast quantities of water and go without replenishment for a week at a time in the hot climate deserts frequented by the Dromedary and for a month or longer at a time in the cold climate deserts frequented by the Bactrian; 7) and, of course, its signature hump, providing a large storehouse for fat that kept the camels energized for long periods of time. And female camels are capable of producing over one gallon of high fat, high protein milk on a daily basis for up to 11 months out of the year, even when working in a caravan, providing wholesome nourishment as a bonus to their service as pack animals. With the camel's remarkable endurance, striking strength, and many adaptive qualities, it was the perfect means for transporting goods long distances across unforgiving, inhospitable stretches of desert where wheeled vehicles would have utterly failed. The largest caravans were comprised of as many as 3,000 camels. With each one carrying an average of 500 lbs., that meant that such a caravan could carry up to 1.5 million lbs. of cargo, most of it goods for trade. Translated into present-day 40-foot ocean containers, that is the equivalent to as many as 34 containers filled with merchandise."<sup>131</sup>

## **4.7 Bronze Replaces Stone Weapons – War Evolves**

Desire for metals, especially copper and tin which were combined into bronze, were often difficult to find and transport to where they were needed. "Regular trade and communication routes were established between Denmark and the Eastern Alps, between Sumer, Zagros, and Caucasus, Egypt, and Sinai. Moreover, tin and copper ores are rarely close to one another and had to be mined separately then transported to regional centers where they would be smelted."<sup>132</sup>

One of the regions that saw the earliest use of bronze was ancient Egypt. It began around 3,150 BC in the so-called Protodynastic Period of Egypt. It lasted until roughly 2,686 BC, and it was the period in which some of the greatest works of art from Egypt were made and the Egyptian culture gained its distinct character in both religious and architectural aspects.

129 <https://www.britannica.com/technology/ship/History-of-ships>

130 <https://www.sciencedaily.com/releases/2016/05/160509191839.htm>

131 <https://www.aramcoexpats.com/articles/the-camel-a-mighty-force-in-history/>

132 <https://www.ancient-origins.net/history-important-events/bronze-age-0013179>

Metallurgic technological advancement woke the worst attributes of humans. It gradually gave rise to wealth, power and influence, supported conquest and war, hence increased greed and suffering.

## **4.8 Writing Allows Empires to Coordinate Governance**

The invention of writing, as discussed in section 1.3 above, enabled meme sharing at distance which was required to govern an empire and foster a group-sense in its people. Thus the invention of writing in Sumaria and Egypt enabled the Sumerian and Egyptian empires to emerge first. The Summarian/Babalonian/Persian Empire was quite complicated, see<sup>133</sup>. Sumerian civilization emerged in the region c. 3500 BCE, and the Akkadian-speaking people appearing by the 30th century BCE. It was enabled by the Summarian's development of the Cuniform alphabet and writing system which was a major advance in civilization.

“The Egyptian dynastic period started with the reign of Egypt's first king, Narmer, in approximately 3100 BCE, and ended with the death of Cleopatra VII in 30 BCE. During this long period there were times of strong centralized rule, and periods of much weaker, divided rule, but basically Egypt remained one, independent land. The dynastic period should thus be seen as part of a much longer, continuous history. Before Narmer united his kingdom, the land that was to become Egypt consisted of a series of separate Neolithic city-states, supported by agricultural communities and linked together by trade. After Cleopatra's death, Egypt was absorbed by Rome, but many of the old traditions continued.”<sup>134</sup>

The Kingdom of Kush stood as a regional power in Africa for over a thousand years. The writing system was generally the same as that of the ancient Egyptians: hieroglyphic, hieratic, and demotic. This ancient Nubian empire reached its peak in the second millennium BCE, when it ruled over a vast swath of territory along the Nile River in what is now Sudan. Almost all that is known about Kush comes from Egyptian sources, which indicate that it was an economic center that operated a lucrative market in ivory, incense, iron and especially gold. The kingdom was both a trading partner and a military rival of Egypt – it even ruled Egypt as the 25th Dynasty – and it adopted many of its neighbor's customs. The Kushites worshiped some of the Egyptian gods, mummified their dead and built their own types of pyramids. The area surrounding the ancient Kushite capital of Meroe is now home to the ruins of over 200 pyramids—more than in all of Egypt<sup>135</sup>

The Carthage city-state began its life in the 8th or 9th century BCE as a Phoenician settlement in what is now Tunisia. They spoke and wrote in the Punic language. After the destruction of Carthage by the Roman Republic in 146 BCE the Punic language, and writing began to become influenced less by Phoenicia and more by the Berber languages spoken in and around Carthage by the ancient Libyans. Carthage slowly grew into a seafaring empire that dominated trade in textiles, gold, silver and copper. At its peak, its capital city boasted nearly half a million inhabitants and included a protected harbor docks for 220 ships. Carthage's influence eventually extended from North Africa to Spain and parts of the Mediterranean, but its thirst for expansion led to increased friction with the burgeoning Roman Republic. Beginning in 264 BCE, the ancient superpowers clashed in the three bloody Punic Wars in one of which Hannibal's famous invasion via the Alps took place<sup>136</sup>. The last of those wars ended in

133 [https://en.wikipedia.org/wiki/Babylonia#Neo-Babylonian\\_Empire\\_\(Chaldean\\_Era\)](https://en.wikipedia.org/wiki/Babylonia#Neo-Babylonian_Empire_(Chaldean_Era))

134 <https://www.historyextra.com/period/ancient-egypt/when-did-ancient-egypt-start-and-end/>

135 Kush <https://www.history.com/news/7-influential-african-empires>

136 <https://www.theguardian.com/science/2016/apr/03/where-muck-hannibals-elephants-alps-italy-bill-mahaney-york->

146 B.C. with the near-total destruction of Carthage. Today, almost all that remains of the once-mighty empire is a series of ruins in the city of Tunis<sup>137</sup>.

Little is certain about the early Roman kingdom's history, as no records and few inscriptions from the time of the kings survive. However the Roman language, now known as Latin, was written using the Latin alphabet that we still use today and many surviving Roman documents were found in Britain, brought by the invading Romans. According to legend, the Roman Kingdom began with the city's founding *circa* 753 BCE, with settlements around the Palatine Hill along the river Tiber in what is now central Italy. It ended with the overthrow of the kings and the establishment of the Republic *circa* 509 BCE. Due to the Roman Empire's vast extent and long endurance, the institutions and culture of Rome had a profound and lasting influence on the development of language, religion, art, architecture, philosophy, law, and forms of government far beyond the territory it governed. The Latin language of the Romans evolved into the Romance languages of the medieval and modern world, while Medieval Greek became the language of the Eastern Roman Empire. The Empire's adoption of Christianity led to the formation of medieval Christendom. Greek and Roman art also had a profound impact on the Italian Renaissance. Rome's architectural traditions served as the basis for Romanesque, Renaissance and Neoclassical architecture, and also had a strong influence on Islamic architecture. The corpus of Roman law has its descendants in many legal systems of the world today, such as the Napoleonic Code. Rome's republican institutions have left an enduring legacy, influencing the Italian city-state republics of the medieval period, as well as the early United States and other modern democratic republics.<sup>138</sup>

In what is now known as China, the Shang dynasty, also historically known as the Yin dynasty, ruled the Lower Yellow River Valley in the second millennium BC, succeeding the semi-mythical Xia dynasty and followed by the Zhou dynasty. Their written language, a central determinant of the development of a civilization, was the earliest of what is now known as the Chinese writing system. It was the first writing developed in East Asia. The classic account of the Shang comes from texts such as the *Book of Documents*, *Bamboo Annals* and *Records of the Grand Historian*. The Xia–Shang–Zhou Chronology Project dated them from c. 1600 to 1046 BCE based on the carbon 14 dates of the Erligang site<sup>139</sup>.

The Maurya Empire<sup>140</sup> in what is now known as India was a geographically extensive Iron Age historical power based in Magadha and founded by Chandragupta Maurya which dominated the Indian subcontinent between 322 and 185 BCE. Comprising the majority of South Asia, the Maurya Empire was centralized by the conquest of the Indo-Gangetic Plain, and its capital city was located at Pataliputra (modern Patna). At its zenith, the Empire stretched to the northern natural boundaries of the Himalaya Mountains, and to the east into Assam. To the west, it reached beyond modern Pakistan and significant portions of Afghanistan. Their language was known as Sanskrit, and its written version as Sanskrit (note the difference in spelling)<sup>141</sup>. The empire was the largest political entity that has existed in the Indian subcontinent, extending over almost 2 million square miles at its zenith under Ashoka<sup>142</sup>.

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137 <https://www.history.com/news/7-influential-african-empires>

138 [https://en.wikipedia.org/wiki/Roman\\_Empire](https://en.wikipedia.org/wiki/Roman_Empire)

139 [https://en.wikipedia.org/wiki/Shang\\_dynasty](https://en.wikipedia.org/wiki/Shang_dynasty)

140 [https://www.newworldencyclopedia.org/entry/Maurya\\_Empire](https://www.newworldencyclopedia.org/entry/Maurya_Empire)

141 <http://mauryanempire16.weebly.com/writing-system.html>

142 [https://en.wikipedia.org/wiki/Maurya\\_Empire](https://en.wikipedia.org/wiki/Maurya_Empire)

## 4.9 Exploiting External Energy – The Industrial Revolution

The exploitation of chemical and electrical energy took a convoluted path of invention and exploitation that no one could have foreseen would lead to factories and Mass Production. Water powered and wind powered gristmills for grinding grain into flour had been used since the 9<sup>th</sup> century in Iran and the 12<sup>th</sup> century in Europe<sup>143</sup>. Those mills were built in rural areas where the water, the wind, and the grain were found in close proximity.

With the advent of coal-fired steam engines, mankind's almost complete dependence upon muscle power to do the hard work was over. Prior to steam, animal or human muscles pulled the plows and wagons on farms and the wagons that delivered produce to town markets, and pulled the ropes that lifted stones at Stonehenge or dragged the huge stones that comprised the pyramids as well as the Greek Parthenon and Roman Colosseum, and all other stone creations such as the castles in Europe.

Thomas Newcomen's "atmospheric-engine", a steam engine invented in 1712, was created to pump water out of coal mines<sup>144</sup>. Coal was in high demand to heat the buildings in the large European cities that had proliferated by then. It offered more energy than wood fires and was often found where wood was scarce. The coal itself was dug out of the ground and distributed to the cities primarily by muscle power or wind-driven ships. Then James Watt developed a rotating steam engine that could run machines in factories in 1774. And those steam engines could be used to power boats and tractors. Then in 1802 steam powered railways began to emerge<sup>145</sup>. However, steam powered factories<sup>146</sup> had a much stronger effect on the world's cultures, hence on the world's pool of memes:

“The Industrial Revolution created a great deal of change in society. One major change was the shift from work being done at home by hand in cottage industries to work being done in factories. There were harsh and unsafe working conditions in these early factories. The machines posed a significant threat to workers' lives. Even more deadly was work performed in coal mines. Owners of mines and factories had considerable control over the lives of laborers who worked long hours for low pay. An average worker would work 14 hours a day, six days a week. Fearful of losing their jobs, workers would typically not complain about the horrible conditions and low pay. Owners realized that they could pay women and children less than men. Child labor increased because it kept the costs of production low and the profits high. As a result, the working class lived in poverty, while the bosses who made up the middle class grew wealthy.

The Industrial Revolution marked a dramatic change for women as many of them entered the work force for the first time. Women had to compete with men for jobs. Female factory workers often made only one-third as much as men. Women began leading reforms to change this. As women became more involved in politics, some began to demand suffrage, the right to vote. By 1918, Great Britain granted women over 30 the right to vote. The United States granted women suffrage with the passing of the 19th amendment in 1920.”<sup>147</sup>

Steam powered factories slowly died out once oil became common. John D. Rockefeller founded

143 <https://en.wikipedia.org/wiki/Windmill>

144 [https://en.wikipedia.org/wiki/History\\_of\\_the\\_steam\\_engine#Savery\\_steam\\_pump](https://en.wikipedia.org/wiki/History_of_the_steam_engine#Savery_steam_pump)

145 [https://en.wikipedia.org/wiki/Steam\\_locomotive](https://en.wikipedia.org/wiki/Steam_locomotive)

146 [https://www.uvm.edu/landscape/dating/industrial\\_architecture/steam\\_factories.php](https://www.uvm.edu/landscape/dating/industrial_architecture/steam_factories.php)

147 <https://www.lcps.org/cms/lib4/VA01000195/Centricity/Domain/10599/Social%20Effects%20of%20the%20Industrial%20Revolution.pdf>

Standard Oil Co. in 1870. As a result he became the richest person in the country, controlling 90% of all oil in the United States at his peak. Petroleum was used to fuel the automobiles that changed the landscape of America and the world<sup>148</sup>. In addition to making the vast regions in the American West accessible, it is argued that petroleum was the factor that decided WW-I, the *Great War*. According to the French economist Francis Delaisi, “the victory of 1918 was simply the triumph of the Allied truck over the German railway – the first being driven by fuel and combustion engines, the second by coal.” The control of strategic resources, including petroleum, had a decisive influence on the outcome of World War I. With the exception of Great Britain and the United States, all warring parties realized too late that motor vehicles and fuel would become factors of military importance. With the advancement of the war, this lack of vision would come back to haunt the Central Powers and their allies<sup>149</sup>.

In the late 1800s, practical and powerful electric motors were developed which allowed factories machines to be powered by electricity. Electric motors were quieter and more controllable than combustion engines, but also they emitted no exhaust, and the power could be brought into the factory more easily. At least as important was the fact the use of electrical power could be separated from its generation, whether by coal or oil, much more efficiently and many miles out of the city. And with Edison’s incandescent electric lights it made sense to distribute electric power to all buildings and homes to replace candles and kerosene lamps.

It should be noted here that the large scale burning of coal, and oil was a blessing in the 19<sup>th</sup> century, but has become a curse in the late 20<sup>th</sup> century and beyond as the CO<sup>2</sup> from burning hydrocarbons has initiated a global climate change that may already be beyond control. Some areas of the world have begun to replace as much as possible of the hydrocarbon usage with nuclear, solar, wind, and water power generation. But so far it is clear that the “Global warming” meme has not spread well in the everyday populace of many areas of the world<sup>150</sup>.

## 5 Group Faith and Spirit

Most sorts of memes originate in individual minds. One sort which we will call a group spirit, arises only in groups. The most obvious examples occur in audiences sharing the spirit of performances or rituals. Musical concerts, sports events, plays, dances, weddings and funerals, and religious gatherings are the most common such gatherings that give rise to specific spirits.

Orators have long been able to motivate a crowd emotionally. Hitler brought huge crowds together in hate and misguided patriotism. Trump brings crowds together similarly, with ‘Make America Great Again’ or ‘Send them back’ ( ‘them’ referring to immigrants who aren’t white). Martin Luther King’s ‘I have a dream’ speech was the opposite of Hitlers and Trump’s messages of hate. ‘Give Me Liberty or Give Me Death’ said Patrick Henry promoting the American Revolution. Winston Churchill’s addressed the fight with Hitler’s Germany saying ‘we shall fight on the beaches, we shall fight on the landing grounds, we shall fight in the fields and in the streets, we shall fight in the hills; we shall never surrender,’ during WW-II. Mahatma Gandhi said ‘A man is but a product of his thoughts. What he thinks he becomes’ and ‘Live as if you were to die tomorrow. Learn as if you were to live forever’. And Thucydides during the Punic Wars in ancient Greece said ‘The secret to happiness is freedom... And the secret to freedom is courage’. We know these sayings today because they were so noteworthy

148 <https://axleaddict.com/auto-industry/Affects-of-the-Automobile-on-Society-and-Changes-Made-by-Generation>

149 <https://encyclopedia.1914-1918-online.net/article/petroleum>

150 [https://en.wikipedia.org/wiki/Climate\\_change\\_opinion\\_by\\_country](https://en.wikipedia.org/wiki/Climate_change_opinion_by_country)

that they survived over the centuries.

## **5.1 Artistic Performances**

Plays, such as those of Shakespeare affect an audience as speeches by the great orators do. They assume that most in the audience have encountered the play before, yet the plot and the acting are artful enough that the performance evokes a series of feelings over the time span of the performance. Thus they leave the audience at the end of the play with a quite complex reaction. Other very moving plays include: *The Cherry Orchard* by Anton Chekhov, *A Streetcar Named Desire* by Tennessee Williams, *The Clean House* by Sarah Ruhl, *The Importance of Being Earnest* by Oscar Wilde, and *Who's Afraid Of Virginia Woolf?* by Edward Albee.

Orchestral performances in the Western tradition, such as Beethoven's 5<sup>th</sup> Symphony, Mahler's 8<sup>th</sup> Symphony, and Mozart's Symphony No. 41; Operas e.g., *Lucia di Lammermoor* (1835) are performed in many cities and nations. In other cultures there are other kinds of performances, e.g., Japanese Kabuki theater, or Javanese puppet theater thought to date back to the first century when it was imported from India or China. Catholic "passion plays" are performed annually in many places in Western civilization. In Southern India, Kathakali plays are characterized by elaborate costumes and make up, and distinctive gestures and body movements performed in perfect timing to music. In Nigeria, in the Igbo culture, there are annual "Masquerades" in which participants wear elaborate masks and perform stylized dances<sup>151</sup>.

## **5.2 Large Sporting Events**

Aside from religion, the most common events that generate strong group spirits are large sports events: e.g., baseball, soccer, and football, among others. In China, there is the "Great Wall Marathon"<sup>152</sup>. In India, Cricket is the most popular sport. In Africa and Brazil, football (meaning soccer) is the most popular and passionate sport, but also Capoeira: a combination of dance and martial art. In South Africa and Australia, Rugby is most popular. The point here is not the sport, per se, it is the degree to which large portions of the crowd become passionate about cheering on "their" team and in some cases in booing the other team. A sports spectator is expected to know quite a bit about how to play, but also typically to root for a team with which they share some "Group Mind" such as a town or city or state, or a club, college or high school

## **5.3 Religious Spirit**

The notion of a spirit that is strongest in church gatherings is very much connected to the notion of an afterlife in virtually all religions<sup>153</sup>. Moreover, wholehearted devotion to participating in the religion is believed by virtually all religions to have an effect on one's experience of that afterlife.

The best known religions are: Catholicism, many various Protestant denominations of Christianity, Buddhism, Confucianism, Taoism, Islam, Hinduism, Jainism, Judaism, Shinto, Sikhism, and Taoism. Together those religions account for 83% of the world's population. The groups with more than 5%<sup>154</sup>

151 See <https://www.igboguide.org/HT-chapter9.htm>

152 <https://www.chinahighlights.com/festivals/huangyaguan-great-wall-marathon.htm>

153 <https://en.wikipedia.org/wiki/Afterlife>

154 <http://www.888c.com/worldreligions.htm>

of the people are: Christian 30.9% (among them, Catholic 50.1%, Protestant 36.7%, Orthodox 11.9%), Islam 22.1%, Secular (agnostic, atheist, non religious) 16.2%, Hindu 13.9%, traditional Chinese religions (Confucianism, Taoism) 5.8%, and Buddhism, 5.5%. Note that Judaism, which has had a strong influence in the world has only 0.21% of the world's population. Thus sheer size does not reflect a religions impact.

Religions typical have specific places where people gather to worship: Cathedrals, Churches, Shrines, Temples, Synagogue, Mosques, Basilicas, and the like, or in some places the Holy place may be outdoors. The adjective 'Holy' is itself a statement of the serious connection to the religion and thus to the afterlife. Since adherents consider the afterlife very important to them and therefore it behooves them to participate in the spirit of the religion as fully as possible, most of the religions go to great lengths to make their places of worship foster and support a spiritual attitude. Catholic and other Christian groups typically build awe inspiring cathedrals in centers of their faith. Similarly Islamic Mosques are often spectacular buildings<sup>155</sup>. Temples such as the Beit el-Wali temple in Nubia (now Egypt) built by Ramses II before 1000 BC, or the Hagia Sofia Mosque in Istanbul (begun as a Christian cathedral in 360 AD), or the Angkor Wat Buddhist (initially Hindu) temples in Cambodia (built between 802 and 1220 AD), or the Tsurugaoka Hachiman-gū Shinto shrine in Kamakura Japan (begun in 1063 AD), or Westminster Abbey in London (begun by Henry III in 1245 AD), or St. Peter's Basilica in Rome (begun in the 16<sup>th</sup> century). These temples were built by a wide variety of cultures and religions. The symbols and architecture of these structures elevate the role of religion by dwarfing our day-to-day concerns.

Temples are a reflection of the fact that our immediate environment affects our non-verbal spirit, typically subliminally, thus a group together in a temple tend to be pulled into the group spirit desired by the religion.

## 6 Group Minds

As we discuss in considerable detail in Appendix 1, minds can be thought of as webs of memes. Brains store information in various ways that one way or another encode all the various memes. The first receiver for incoming memes is short-term memory where some memes contribute immediately to current "thinking", i.e. navigating, or talking. Some thereafter become consolidated into long-term memory<sup>156</sup>. Research has shown where much of both short-term and long-term memory lives in the brain<sup>157</sup>. However virtually nothing is known about exactly how memories are encoded, stored, or used in in the brain's memory<sup>158</sup>. How the brain "parses" its sensory inputs is also mostly a mystery. Some is known about how visual and auditory inputs are recognized but we know very little about how "thinking" or "reasoning" or parsing language is accomplished. So terms like "mind" and "think" are not formal scientific terms at all. They are descriptive words in the vocabulary of most languages and it is clear that not all languages treat them the same. If those words had one clear definition, many if not most languages would have one word translations for them as they do for words such as "hand" or "stomach" or "eat". But such is not the case. Few languages have one word translations for either

155 <https://www.khanacademy.org/humanities/ap-art-history/introduction-cultures-religions-apah/islam-apah/a/introduction-to-mosque-architecture>

156 <https://www.scientificamerican.com/article/how-do-short-term-memories-become-l/>

157 <https://qbi.uq.edu.au/brain-basics/memory/where-are-memories-stored>

158 <https://www.frontiersin.org/articles/10.3389/fnsys.2018.00052/full>

“mind” or “think”<sup>159</sup>. In the case of “mind”, only about 25% of languages have one word translations: Russian has 20 possible translations, Greek 23, German 18, Norwegian 16, and Swedish 35. For “think”, perhaps 45% have one word translations, but French has 12, Italian 7, Dutch 11, and Kurdish 10. But in what follows we have no choice but to use those words the way English speakers do.

## **6.1 Group Minds and Group Thinking**

Except for those born with serious brain dysfunction and the handful of children raised by social animals such as wolves, dogs, or chimps, every human has been constantly exposed to other human’s memes and native language throughout their lives. With the exception of a few completely isolated tribes sprinkled around the world<sup>160</sup>, no groups of people live their lives isolated from all other cultures or languages.

Throughout human history, new memes arise frequently in a person’s mind and are often shared with at least one other person – a spouse, best friend, co-worker – who in turn may share with one or more other people. The meme typically changes at least slightly at each step in that process due to imperfect communication or to different biases in each receiver. At times, the receiver passes on a quite different viewpoint, especially with political memes about current events. Thus an alternate version of the meme may proliferate too. And thereby memes evolve. Variants of many memes outlive individuals, families, villages, tribes, cities, cultures and even civilizations. Western civilization still contains memes from the ancient Persian Empire, the Egyptian Empire, the Greek Empire, the Roman Empire, the Arab Empire (or Caliphate), and the British Empire. And those sources undoubtedly carried forward many memes from ancestral African roots and from the Kingdom of Kush (discussed above).

Memes about everyday life such as how to obtain food, build shelter, or obtain clothing appropriate to the local climate necessarily are passed down from generation to generation, perhaps for many hundreds of generations. Religious memes about the supernatural world are also passed from generation to generation. Memes in Buddhism, Judaism, Christianity, Shinto, and various African religions are thousands of years old. Thus these memes help create and participate in what we might call a “group mind” however imprecise that term might be. Individual people’s minds encode memes and juxtapose memes to come up with new ideas. Thus when current events bring some set of memes to several people’s minds and thereby cause them to talk about or otherwise “process” these memes as a group, they are doing something analogous to an individual’s thinking. It seems reasonable to call that “group thinking”, or “group meme processing”.

The time course of group thinking depends upon the topic and the media in which it occurs. For example, a large stock market market plunge, which always is processed quite quickly is nonetheless exacerbated by Twitter which many market traders use for “real-time” commenting on what’s happening in the market and where it might be going. Other sorts of group thinking, perhaps about world political affairs may take place primarily in more stable written forms, e.g., in newspaper opinion pages, on websites and blogs, and even in very slow media such as the Foreign Affairs<sup>161</sup> monthly periodical. Legislative deliberations in democracies epitomize the group thinking processes, mixing both private and public verbal and written arguments.

The number of memes in group minds of homo sapiens 40,000 years ago was undoubtedly quite small

159 See: <https://www.definitions.net/translate/think> (replace think with whatever word you wish to see translations of)

160 [https://en.wikipedia.org/wiki/Uncontacted\\_peoples](https://en.wikipedia.org/wiki/Uncontacted_peoples)

161 <https://www.foreignaffairs.com/>

compared to today's group minds that have evolved in thousands of cultures and encode their knowledge in thousands of languages. Humans have collected and share vast bodies of knowledge of the world's geography, animals, plants, weather, geography and, in the last millennia, technologies and sciences. For example, we now have an enormous knowledge of astronomy – about our solar system, other stars, billions of galaxies, dark matter, supernovas, etc. that simply did not exist at all five hundred years ago. Prior to Galileo in about 1600 AD, virtually everyone believed that the sun, stars, and all other astronomical bodies circled the Earth and people of all cultures imagined astronomical bodies to be supernatural beings. When Galileo was born there was no such thing as 'science', yet by the time he died science was well on its way to becoming a discipline and its concepts and method a whole philosophical system.<sup>162</sup> Geology has advanced similarly<sup>163</sup>. We now know much about the planet Earth, its core, its volcanoes, its geology, its oceans and glaciers and polar ice caps. And we fly across the Atlantic or Pacific Oceans rather casually for vacations. And because of the tilt of Earth's axis, summer in the Northern Hemisphere is Winter in the Southern Hemisphere, so long North-South trips tend to be much rarer than East-West travel. Geography matters in meme hydrology as much as it does in the movement of water.

## **6.2 How Group Minds Grow and Change**

For as long as there has been language (most experts estimate over 40,000 years) people shared verbal memes. Prior to the development of language, people shared non-verbal memes too, but most such memes were absorbed into language as words were invented to represent them. Groups tens of thousands of years ago were small and tended to be isolated, so the number of memes a group used was presumably small, perhaps no more than several thousand. A 19<sup>th</sup> century example of an isolated tribe of Tasmanian Aborigines found that they had limited powers of abstraction or generalization. Each variety of gum tree and wattle tree, etc, had a name but there was no name for "tree". And there were no words for abstract qualities such as hard, soft, warm, cold, long, short and the like<sup>164</sup>.

Steven Pinker asserts that "The reason that we live differently today from the way the cavemen lived is not because we have better brains but because we've been accumulating all of the thousands of discoveries that our ancestors have made, and we have the benefit of a huge history of inventions that we communicate non-genetically, through language, through documents and recordings, through customs."<sup>165</sup> But Pinker used the quantity "thousands" loosely. There are really millions, if not billions, across cultures and languages, although no one has or could count them and each person could know only a minuscule fraction of them.

For example, a single brand/year/model of a car has about 2,000 unique parts (not counting screws, bolts and nuts). A Boeing 747 has about 3 million parts with another 3 million fasteners holding it all together. Each part of a car, plane, train, bus, or ship has a name and a special shape and fits together uniquely with certain other parts. To the people working the assembly lines or mechanics who work on the various transport machines, all those names are unique and identifiable memes. The same is true of pipelines, power generation and transmission lines, heavy construction machinery, skyscrapers, houses, stores, office buildings, streets, and the complex public utility mechanisms that are under the streets, accessible via manholes. Geographic features worth noting have names and locations (mountains, hills,

162 <https://plato.stanford.edu/entries/galileo/>

163 [https://en.wikipedia.org/wiki/History\\_of\\_geology](https://en.wikipedia.org/wiki/History_of_geology)

164 "Vocabulary of the Dialects of Some of the Aboriginal Tribes of Tasmania" By Joseph Milligan, 1890, p, 11

165 [http://www.reviewevolution.com/viewersGuide/Evolution\\_06.php](http://www.reviewevolution.com/viewersGuide/Evolution_06.php)

creeks, rivers, lakes, bays, oceans, glaciers, etc.) known to the locals. There are about 8.7 million species on the planet Earth<sup>166</sup> most of which are named (typically in Latin) and cataloged. Google has cataloged the titles of all the books published in the world; almost 130 million different books have been written. Each of those books contributes hundreds or thousands of memes, including the characters in the novels and the many assertions and references in non-fiction books. Google also crawls and indexes 30 trillion unique web pages. In terms of vocabulary words, some experts assert that “...normal literature written in English makes use of about 10,000 words, while well-educated conversation uses about 5,000 words.”<sup>167</sup> Most other languages have similar sized vocabularies. Given that there are perhaps 7000 languages in the world, there clearly are roughly 70 million different words in everyday use. And there are about 7.5 billion people on planet Earth, each with a name, a family, a location where they normally live, and possessions, pets, etc. Then there are astronomical memes: features on the Moon, Mars, Jupiter, etc., and all the various cataloged galaxies and stars in the sky. There are about 4000 approved pharmaceutical drugs, not to mention quite a few home concoctions and illegal recreational drugs. The US Library of Congress has about 16 million books, including more than 700,000 volumes of *Rare Books and Manuscripts* which include the largest collection of 15th-century *books* in the Western Hemisphere.

All totaled, the human race deals with at least 10 billion memes. Yet humanity began in small groups knowing at most a few hundred other people, and perhaps a few thousand memes each. As group minds of humans grew, the ability to share memes with each other verbally was an evolutionary advantage. That ability grew over time as mankind learned more about their world and thus created more memes. And new sets of memes arose as each large change in human life-style occurred, such as 1) how to farm and domesticate animals, 2) how to create and protect towns such as the walled city of Jericho, 3) how to read and write, 4) how to build ships with oars and sails to travel the Mediterranean, 5) how to use chemical fuel and make steam engines. As the industrial revolution accelerated, motorized vehicles such as trains, cars, and airplanes were developed. Then long distance communication e.g., via telegraph, then phone, then radio and TV brought information formally into the picture

Inclusion of visuals...painting was very old, but photography, movies then TV and movies would each have provided new challenges and skills that some would be better at than others, hence would spread into cultures and become genetic endowments. Similarly, after the industrial revolution, trains, cars, faster ships, and planes, would spread memes faster hence provide another advantage to those who had the right talents, and those talents would also spread by gene transfer...evolution. And then 7) computers and digital transfers, first email, then the Internet, and then Twitter, and other social media. Each advantaged different talents. And Social Media, at the very least, would also tend to create pairings of people who would transmit memes to their “friends”. Cultures without writing (and there are many) were at a disadvantage in evolving better meme pools and/or spreading them once they emerge, but they do their best. Memes also were carried by groups of people as they migrated, or traveled, from culture to culture, language to language, and geography to geography sharing with other groups, e.g, by Meme Hydrology. As each of these groups adopted their own versions of those memes they, in effect, helped to enrich many cultural "Group Mind(s)".

Robert Sternberg of Yale Univ. asserts that “vocabulary is probably the best single indicator of a

166 <https://www.sciencedaily.com/releases/2011/08/110823180459.htm>

167 [https://www.reddit.com/r/linguistics/comments/r0ng6/can\\_a\\_language\\_have\\_only\\_340\\_words/](https://www.reddit.com/r/linguistics/comments/r0ng6/can_a_language_have_only_340_words/)

person's overall level of intelligence. Stated in another way, if one wants a quick and not-too-dirty measure of a person's psychometrically measured intelligence, and thus has time to give just one brief test of it, vocabulary is generally the best predictor of overall score on a psychometric IQ test.<sup>168</sup> Similarly, the number of memes in use in a given group – whether a family or an entire culture – is a plausible measure of its “vocabulary”, hence what might be called the group's IQ. The number of memes in a group varies over time, presumably inexorably growing as humans discover new aspects of their world, and it presumably also grows over time as new levels of culture emerge, e.g., as cave groups branched out after the Ice Age into agriculture, or as boats began exploring the coasts of the Mediterranean, or 25,000 years ago when people slowly moved over the Bering land bridge from Asia to Alaska<sup>169</sup>.

### **6.3 Memes in the Internet**

The Internet embodies a sample of the entire world's group mind. It is chaotic, disputatious, and massively immoral (lying, fraud, theft of intellectual property, scams, and porn are rampant). Nonetheless it spreads mankind's vast trove of memes widely and almost instantaneously to every corner of the earth.

The Internet distributes data world-wide at a rate of about 295 Terabytes per second (in 2017), growing at more than 30% per year.<sup>170</sup> Most people in at least moderately developed countries now communicate primarily by digital devices such as Smartphones exchanging email, texts, Tweets, and other social media, all of which are now digital. The photos and videos we capture are digital. All entertainment other than live events are digital. Virtually all finance, other than the tiny proportion mediated by cash, is digital.

However, communication is not just for, or even primarily for, human meme sharing. Data and compute servers are located in more than half a million server-farms around the world. The digital world inexorably becomes more and more complex. It records our emails, phone calls, eCommerce purchases, searches and social media interactions. Facebook also analyzes all this data for hints about our buying preferences, our opinions and even for the identity of those that appear in our photos (using AI based face recognition). Google's many server farms around the world repeatedly spider virtually all web-pages cataloging their content so that it can recommend the page it judges to be what we are looking for (or perhaps what they think we should be looking for) when we browse the Web. Other servers at data centers owned by the likes of Amazon, Switch, Microsoft, Twitter, and the NSA gather and store different sorts of data for many known and unknown purposes. There are millions of servers that store, catalog, and make searchable information about people, products, businesses, real estate, government activities, universities, weather, crops, livestock, and almost anything else one can imagine. Perhaps the simplest way to summarize the impact of computing on the world is to note that that in 2016 Global data and compute centers used about 3% of the world's total electricity (a fact that was astounding back then). Recent estimates suggest that by 2025 computing could use 20% of the world's power.<sup>171</sup> And that was prior to the COVID-19 pandemic where millions of employees are

168 From a chapter by Robert J. Sternberg (Yale Univ.) in *The Nature of Vocabulary Acquisition*, edited by M. G. McKeown, M. E. Curtis, 1987

169 <https://www.scientificamerican.com/article/first-americans-lived-on-bering-land-bridge-for-thousands-of-years/>

170 <https://blog.telegeography.com/295-tbps-internet-traffic-and-capacity-in-2017>

171 <https://www.theguardian.com/environment/2017/dec/11/tsunami-of-data-could-consume-fifth-global-electricity-by-2025>

doing their work from home via Skype or Zoom or other such live connection systems over the Internet. That has caused the volume of internet traffic to increase by 40-50% just between February 1<sup>st</sup> and the end of April as people who used to work at the office using WiFi or hardwired computers switch to using Internet connections from home. The number of computers running long hours every day has presumably risen as well. And there is good reason to believe that a substantial proportion of the “work from home” movement will continue after the pandemic is over.

Meme transfer via the internet occurs in point-to-point media such as email, voice messages and texts where the sender knows the addressees personally and sends the message for some specific purpose, no matter how serious or frivolous, as do the receivers who listen to or read it. Email in a primitive form actually began in the 1970s and became widely used in universities and research facilities in 1977-78. Text messages, limited to 160 characters began in 1993. Voicemail has such a long and tangled history that its origins are murky. But voicemail on cell phones has been around at least since the year 2000. And modern email was first released by Mozilla in 2003.

Modern social media began with Twitter in 2006. “In 2012, more than 100 million users posted 340 million tweets a day<sup>172</sup>. Because Twitter did not support “friends”, or topic groups, a few Twitter users promoted the idea of hashtags to give readers a way to decide if they want to read a given Tweet<sup>173</sup>. They rapidly became very popular.

The subsequent problematic “addiction” to Social Media<sup>174</sup> was triggered largely by Facebook together with the very wide-spread addiction to Smartphones<sup>175</sup>. The number of “friends” a Facebook page had signed up became a point of pride and people began seeking friends just to get the record, which in 2012 was apparently 8,942! Facebook found it necessary to limit their users to at most 5,000.

During the 2016 Presidential election, computers using AI were tasked by the Russians and Cambridge Analytica (a British company) with generating and widely spreading propaganda about both the British “Brexit” election and Donald Trump’s election campaign as US President. These propaganda campaigns created millions of fake Facebook pages and Twitter accounts (and other social media accounts), and filled them with AI-generated fake opinions and observations that fitted with the artificial persona of the fake people who supposedly “owned” the accounts. Since memes are inextricably intertwined with and originate in human minds, these AI-generated words and phrases are best called fake-memes or pseudo-memes. However once they have been inserted into human minds via social media that will be passed along by the humans, they become “real” in the sense that neither humans who spread them nor the ones that receive them are aware that they were computer generated.

Mankind will slowly create legal constraints against pseudo-memes, of course, and must do so. When the bad actors are another nation state, e.g., Russia, we in the West may resort to cyber-warfare. In retaliation. Reports from the BBC and the NY Times suggest that such counter attacks may already have happened<sup>176</sup>. But at the speed that AIs can fill the Internet with disinformation, deceptive ads, and other propaganda, there must be counter AIs constantly working to identify pseudo-memes, and suppressing them, blocking them, and identifying the sources (both instigating machines on the net, and the human actors behind them). Honeytraps and other techniques are at least a start at identifying

172 <https://en.wikipedia.org/wiki/Twitter>

173 <https://socialmediaweek.org/blog/2018/02/history-hashtags-symbol-changed-way-search-share/>

174 [https://en.wikipedia.org/wiki/Problematic\\_social\\_media\\_use](https://en.wikipedia.org/wiki/Problematic_social_media_use)

175 <https://www.bbc.com/news/education-50593971> or <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5076301/>

176 <https://www.bbc.com/news/technology-48675203> and <https://www.nytimes.com/2019/06/15/us/politics/trump-cyber-russia-grid.html>

pseudo-memes, However more is needed. Do we set AI defensive systems to countering AI-driven bots and thus generate a computer/AI against computer/AI competition that humans can only sit by and watch? Or do we stay withing the human realm and deal instead with the people or institutions, whether corporations or governments who exploit computing? AI-generated memes intended to deceive are so new that it may take years for such questions to be answered.

## 6.4 Memes in the Cloud

Mankind's relationship with memes is being changed again by the Cloud which has effectively infinite storage, every communication between people can be stored forever and searched out easily: every Tweet, every silly facebook page, every YouTube whether legitimate or a "deep fake", every lie told by everyone on the Internet in any media will survive arbitrarily long. Just as the inception of writing on stone or clay millennia ago made some memes permanent, the Cloud *seems likely to make every Internet contribution permanent*. Only this time, it doesn't have to wait until some useful portion of the populace becomes literate.

What will unfold from that change? Can permanent libelous messages be prosecuted if their intent was to be a private gmail message from one person to one other but Google saw fit to save it and a year later someone else finds it and makes it public? People tend to think their messages are private, but they are no more private than stone or clay tablets unless you encrypted them with a good key, which very few people do, and in any case with essentially infinite compute power, any encryption can eventually be undone. A Wall Street Journal article examines some of the foreseeable impacts on society<sup>177</sup> and discusses some ethical issues:

"Ethics in the cloud. Data can help businesses make more personalized and informed decisions, but there are big ethical questions surrounding it, particularly in the context of AI and machine learning. Vast quantities of consumer data are being amassed into centralized cloud repositories and analyzed for a multitude of purposes. Besides the inevitable security and privacy risk associated with data repositories, the bigger issue may be who draws the line in terms of how the data gets used. The temptation to provide increasingly customized services can very quickly start to push against ethical boundaries and privacy concerns—not to mention regulations. And when decisions are made by machine learning models or other similar technologies, they can reflect and even exaggerate the biases of the people who built those systems, with potentially negative consequences for affected consumers."

The WSJ article also explores the liklihood that forward thinking businesses will create nontraditional ecosystem relationships with unexpected costs and benefits. Clearly, if they do it well, those businesses will reap the benefits while everyday consumers are likely to somehow bear at least some of the costs. They also foresee a new "digital divide" in which workers at businesses that exploit the cloud may well need to learn new skills or adopt new roles. And finally, they wonder about the longer term consequences. So, the WSJ asks: "Are cloud-enabled technologies really a democratizing force, or will they end up creating a more monopolistic or oligopolistic society?"

Privacy is not all that is affected by the cloud. Relatively cheap massive compute power also has consequences. Creating BitCoin or its like may be one such, building personal contact graphs (such as is being done to track contagion paths of the COVID-19 virus) is another. Running very compute

<sup>177</sup> <https://deloitte.wsj.com/cio/2018/11/14/the-societal-impact-of-cloud/>

intensive simulations of various properties in the world is yet another. Bits of data that no one thought of as memes can become memes when computer analysis puts many together for a purpose. Recall that the difference between raw bits and memes is precisely human purpose! The cloud is so new that many purposeful uses of the cloud have yet to be invented.

## 7 Summary and Conclusions

A rich language separates modern humans from the likes of Homo Erectus, other primates such as the bonobo<sup>178</sup>, elephants, dolphins, wolves, and parrots that teach their young many aspects of life but have no “verbal” memes beyond sounds of different pitch and duration<sup>179</sup>. Parrots can “talk” but only because they have been taught by people. And elephants communicate well as do parrots in the wild. They chatter away, but they don’t create new complex sounds that accumulate and share them in a way that creates cultures. Groups of primates and other intelligent species have no more culture today than they had a million years ago.

The first species to use language is a complicated topic. Yet we pose a different question: which species was first able to communicate some sort of memes in order to teach them to their children and to create a body of memes that grew over time within their groups, i.e., Group Minds. How may they do that without full language? Perhaps with a combination of a primitive verbal language combined with complex gestures that might amount to primitive sign language. In Plato's *Cratylus*, Socrates says: "If we hadn't a voice or a tongue, and wanted to express things to one another, wouldn't we try to make signs by moving our hands, head, and the rest of our body, just as dumb people do at present?"<sup>180</sup> So, rather than ask when the first language arose, it behooves us to think about just what sort of behavior indicates that a group of people fosters growing bodies of memes? One such behavior is the ability to migrate into widely different geographies thousands of miles apart. New geographies inevitably have different plants and animals (for hunter/gatherers that matters), different climates and different predators. It takes considerable creativity to adapt to each new geography: from deserts to mountains to high grassy plains and to marshes, to crossing rivers and carrying water to make it through dry areas, and to adapt hunting strategies to the types of game found in new areas. And as the scouts who discover areas to favor and areas to avoid return to the group, they must be able to share what they learned. As it turns out, *Homo Heidelbergensis* and *Homo sapiens* remains are found widely in Africa, Europe, and Asia<sup>181</sup> which strongly suggests that they could learn, store, and transmit memes to others. *Homo Neanderthalensis* and *Homo Erectus* fossils are also found somewhat widely. Another indication comes from cranial size, and here again, *H. Neanderthalensis*, *H. Sapiens*, *H.* and *H. Heidelbergensis* are the largest, with cranial sizes from 1240cc to 1500cc, and with *H. Erectus* next largest at 1000cc.

New technologies that foster or change the course and speed of meme movement have arisen in unpredictable places and times since writing was invented. None of these technologies have been

178 [https://www.smithsonianmag.com/science-nature/bonobos-teach-humans-about-nature-language-180975191/?utm\\_source=smithsoniandaily&utm\\_medium=email&utm\\_campaign=20200707-daily-responsive&spMailingID=42898165&spUserID=OTU2MzA2NzExNjMwS0&spJobID=1800542143&spReportId=MTgwMDU0MjE0MwS2](https://www.smithsonianmag.com/science-nature/bonobos-teach-humans-about-nature-language-180975191/?utm_source=smithsoniandaily&utm_medium=email&utm_campaign=20200707-daily-responsive&spMailingID=42898165&spUserID=OTU2MzA2NzExNjMwS0&spJobID=1800542143&spReportId=MTgwMDU0MjE0MwS2)

179 <https://www.evolutionofcomputing.org/AdamsBurbeck-BeyondOctopusAGI-final.pdf>

180 [https://en.wikipedia.org/wiki/History\\_of\\_sign\\_language](https://en.wikipedia.org/wiki/History_of_sign_language)

181 <https://www.britannica.com/topic/Homo-sapiens>

neutral – each biases the kinds of memes that proliferate beyond verbal interchanges according to the accessibility of the technology itself as well as the abilities and desires of various people, geographies, cultures, and languages to access and use the new technologies. Each technological advance either enables or speeds the movement of information to a wider range of people, or enables people to move more easily to geographies where they can benefit from the new information and resulting new lifestyles provided thereby. The printing press, for example, aided primarily those who could read and write and lived in, or moved to, more urban areas where the printed materials were accessible. The invention and acceptance of the Industrial Revolution allowed humans to escape the confines of living in groups that can only be provisioned by weekly village markets or from more distant places via camel caravans or crude rafts on the Nile or Euphrates or Congo rivers and the like.

Digital computing enabled so many other technological changes that could not have been foreseen that the changes in the last few decades far outstrip changes in an entire prior century. Memes that once were communicated by speech or gestures to one or a few nearby people now can jump continents in the form of YouTubes and the like, complete with all the facial expressions, verbal intonations, and gestures plus the ability to show the person on the other end of the conversation whatever you can see nearby yourself, and to see their surroundings as well.

All these issues aside, we cannot avoid the central fact that over tens of thousands of years, mankind's overall pool of memes has grown inexorably. Early small groups of hunter-gatherers could know little if anything about the state of the world beyond the distance that one could walk in a few days. In the modern world we watched men walking on the moon and robots on Mars and we vicariously explore much of the universe via telescopes. Yet all those advances were based upon a sequence of a few major cultural transitions: to agriculture, to cities, the invention of writing, the capabilities of early ships, whether rowed or sailed, then the growth of empires, and then the Industrial revolution. Into that mix, in the 1950s came computing, which cemented the electronic revolution...and then, in the early 1970s, the infant Internet was born. At that point its impact was comparable to the early days of Cuneiform and Hieroglyphic writing. It was used for what its inventors intended and was successful at those tasks. Yet they had not a clue that something called "The Web" was just around the corner, and they could not even imagine where the Web together with smartphones would lead. Nor did the inventors of Twitter and Facebook foresee what their inventions would bring, nor did the people at Apple who created the smartphone.

Even though the revolution caused by the Web, social networks, and the Cloud is still in its infancy. Where it will lead in the next decade or century is a wonderful unknown. The complexity and subtlety of humans as individuals and as participants in group minds will still far exceed those of our creations.

Thus let us restate cultural anthropologist Clifford Geertz's description of mankind with which we began:

"We are, in sum, incomplete or unfinished animals who complete or finish ourselves through culture -- and not through culture in general but through highly particular forms of it: Dobuan and Javanese, Hopi and Italian, upper-class and lower-class, academic and commercial. Man's great capacity for learning, his plasticity, has often been remarked, but what is even more critical is his extreme dependence upon a certain sort of learning: the attainment of concepts, the apprehension and application of specific systems of symbolic meaning."

## Appendix 1: Minds as Webs of Memes

Physically, a brain is a web of interconnected neurons surrounded by glia and astrocytes that somehow support memory<sup>182</sup>. Minds are webs of associated memes encoded in ways that clearly live in the neural web but beyond that simple fact, mechanisms of encoding memes are still mysterious. We have learned much from neurophysiology, brain anatomy, decades of experimental psychology, and from the practical experience of those paid to manipulate our minds (e.g., market 'researchers', PR professionals, creators of advertising and, in the 2016 Presidential election, hijacked social-media accounts in part manipulated by AI systems). Let's look at some of those issues:

- *Cellular physiology* – Neurons make new associative connections, or synapses, to other neurons or modify the “strength” of existing synaptic connections as they are repeatedly stimulated<sup>183</sup>. Thus, whatever terms such as meme, idea, experience, or memory refer to, their underlying physical realization is based on long term modifications of neural connections and/or synaptic strengths, i.e., webs of neural associations. Thus we refer to “webs of memes” with the understanding that they map somehow to webs of neurons.
- *Anatomical and Clinical phenomena* – The primate Association Cortex, is specialized to manage associative memory. “*In humans the association areas are by far the most developed part of the cerebral cortex, and the brain in general. These areas are necessary for perceptual activities, like recognizing objects (toasters, horses, trees, words, etc), rather than simple contours, edges or sensory qualities like color or pitch.*”<sup>184</sup>
- *Experimental psychology* – Psychologists have extensively studied how we create and use associations<sup>185</sup> since the time of Freud (in the late 1890's) and Pavlov (1920's). Associative long-term memory is the best studied and the best understood aspect of memory in experimental and educational psychology<sup>186</sup>.
- *'Scientific' advertising* – Advertising professionals believe, with strong evidence to support their belief, that creative ads can reliably evoke and associate carefully chosen emotions, even 'personalities' with products, brands, politicians, or political parties. Market researchers ferret out potent images, words, short video clips, color themes, and music that evoke various emotional responses in a target audience of consumers or voters. “*Electroencephalography (EEG) measurements can track the exact moments an ad activates memory, draws attention or prompts emotional response, and can determine on an instant-by-instant basis which parts are and are not effective in engaging viewers.*”<sup>187</sup>

Both our perception of a singular conscious mind and the notion that our mind equates to our consciousness are illusions. We tend to believe that we are in control of our mind. Far from it! Consider how the following examples of strong physical environments influence our state-of-mind in

182 <https://www.sciencedaily.com/releases/2018/06/180618222427.htm>

183 Synaptic Signaling in Learning and Memory, Mary B. Kennedy, *Cold Spring Harb Perspect Biol.* 2016 Feb; 8(2): <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4743082/>

184 [http://www.indiana.edu/~p1013447/dictionary/assn\\_cor.htm](http://www.indiana.edu/~p1013447/dictionary/assn_cor.htm)

185 See <http://www.nature.com/nature/journal/v354/n6349/abs/354152a0.html> for a beginning bibliography of papers on the subject of paired associations.

186 [http://psychology.wikia.com/wiki/Introduction\\_to\\_learning](http://psychology.wikia.com/wiki/Introduction_to_learning)

187 <https://www.nielsen.com/us/en/insights/news/2014/the-argument-for-more-effective-short-form-ads.html>

ways not entirely under our control:

- Beauty – a performance of Bach Cantatas. Most in the audience are caught up in the beauty of the music despite whatever day-to-day concerns weighed on them when they entered the concert hall.
- Danger – a hot NATO vs. Taliban firefight in progress in Afghanistan. Danger becomes palpable, adrenaline takes over the soldier's minds, and every moment seems to take forever.
- Natural wonders – an isolated place on the Northern rim of the Grand Canyon where one cannot help but be aware of the awesome scale of geological time and space. Or watching a herd of a thousand Wildebeest in the Serengeti, shows the scale of the world and of life in the world.
- Large urban cultures – Bangkok, Beijing, Berlin, Cairo, Istanbul, Kolkata, Kyoto, London, Mexico City, Moscow, Nairobi, New Delhi, New York City, Paris, São Paulo, Shanghai, Tehran, Tokyo are hubs of major and quite different cultures that mold the minds of people in them.
- Technical wonders – Think of the Baikonur Cosmodrome Launch Control Center in Kazakhstan where an International Space Station crew launch has just begun. The enormous power and sophistication of the launch vehicle dramatizes human technical prowess. A minute or two after launch, as the rocket dwindles into a silent bright speck in the sky, we are reminded of how small a thing that power and our technical prowess is in terms of the scale of the Earth. Conversely, consider the cell-phone cultures in Kenya or India which is primarily based on very cheap “dumb” flip-phones. Yet the cultural impact has been immense. A teenage Masai boy in Kenya who is herding cattle out in pasture-lands far from any town can call and talk with his family about where he has found water or good grazing and when he might return home. Or a farmer in Africa or India can discover up-to-date market prices for his crops. Cell phones change the “hydrology”, i.e., the speed and range of meme flows rather than the memes themselves.
- The follies of greed and gambling – It is difficult to enter a gambling casino, whether in Las Vegas, Monaco, or Macao, without imagining yourself winning a jackpot because everything about those environments is carefully structured and decorated to tempt you. Humanity has long been susceptible to the lure of gambling. Ivory dice existed as early as 1500 BC and gambling existed in China as early as 2300 BC. “Luck”, “fate”, the Greek goddess Fortuna, and other such constructs are noteworthy in nearly all cultures<sup>188</sup>.

In summary, we are not simply in possession of our experiences and in control of our minds, we are also possessed and controlled by them.

188 <http://en.wikipedia.org/wiki/Luck>

## Appendix 2: Fatal Flaws in the Memetics Metaphor

Description and Critique at [https://en.wikipedia.org/wiki/The\\_Meme\\_Machine](https://en.wikipedia.org/wiki/The_Meme_Machine)

Richard Dawkins, the author of “*The Selfish Gene*” asserts that memes “replicate themselves much as genes do.”<sup>189</sup> Nothing could be further from the truth! Yes, genes may be thought of as “selfish” but their replication is nothing whatever like the movement of memes. Dawkins wished “...to transform memetics from a set of speculations into a science of cultural processes.” Mameli criticizes that goal on the grounds that memes aren't enough like genes to justify a view of memetics as analogous to genetics<sup>190</sup>.

Genes move in single rare high fidelity sexual interactions that transfer a whole genome rather than individual genes. In contrast, individual memes or sets of memes, move easily from one person to another via many different and common interactions. Dawkins’ notion of “selfish genes” is based on two early misconception about DNA and genes.

1. **Genes are the unit of heredity.** Dawkins asserted that “...the fundamental unit of selection, and therefore of self-interest, is not the species, nor the group, nor even, strictly, the individual. It is the gene, the unit of heredity.” However the genes in the nucleus of the ovum are not units and are not alone in determining cellular function (mitochondria also have DNA), and there is competition between genes on the male X-chromosome and genes on the female Y-chromosome<sup>191</sup>. Hence the term “the unit of heredity” is a misnomer. Genomes are very complex multi-part structures that cannot be understood by reductionism.
2. **Most DNA is junk.** Dawkins asserted that most of the human genome has no function other than to somehow “get itself” replicated hence in 1972, it was dubbed “junk DNA.” That misconception has withered as more and more non-coding DNA has turned out to have a function at the chromosome level, often to control expression of other DNA segments. It is now clear that at least 80% of the human genome is functional<sup>192</sup>. So much for the “mostly junk” notion. And researchers are beginning to understand how the DNA sequence affects the tertiary and quaternary *shape* of the enormous double helix molecules of DNA or of subsequent RNA<sup>193</sup>. It is quite possible that DNA with no obvious coding function helps instead to create or stabilize a necessary tertiary or quaternary shape of a region.

Finally, DNA does not and cannot “replicate” at all. Cells, not genes, are the agents of replication, and cells copy genomes, not genes. Very complex machinery in eukaryotic cells manages the details of copying the DNA with or without its epigenetic<sup>194</sup> modifications.

189 Available at <http://ndpr.nd.edu/news/24865-the-selfish-meme-a-critical-reassessment/>

190 <https://ndpr.nd.edu/news/the-selfish-meme-a-critical-reassessment/>

191 <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3441658/>

192 Pennisi, E. (Sep 2012). "Genomics. ENCODE project writes eulogy for junk DNA.". *Science* 337 (6099): 1159, 1161.

193 <http://www.sivabio.50webs.com/nucleicacidstructure.htm>

194 <https://www.whatisepigeneitics.com/fundamentals/>

The modern view of the human genome<sup>195</sup> is far different from that of the mid '70s when Richard Dawkins coined the term 'memetics'. It was thought back then that one gene coded for one protein that had one function and that genes are contiguous stretches of the four nucleotide DNA bases (denoted symbolically by A, C, T, G). Those stretches are converted by simple rules to equivalent stretches of RNA which are then converted into a protein. Our understanding of the genome has changed almost beyond recognition in the intervening years. Viz:

1. "Genes" in eukaryotes, especially humans, are not unitary. They instead are divided into many pieces of coding DNA (exons) that are separated by non-coding DNA called introns. And many RNAs are expressed from "non-coding" DNAs, including those within introns, that do not end up encoding proteins but instead fold into independent functional molecular machines or parts thereof.
2. When multiple exons within a stretch of DNA that code for proteins, or parts thereof, are spliced together into protein coding sequences, one "gene" may create dozens of different proteins by varying which exons are spliced together for the final result. Splice variants from one contiguous DNA sequence can have quite different functions and may even act counter to the function of the primary protein product of the gene. "And in one of the most extreme examples known to science, a single *fruit fly* 'gene' provides the recipe for more than 38,000 different proteins."<sup>196</sup>
3. DNA in living cells is not one dimensional. DNA consists of 3-D molecules that bend and fold in varying ways to accept binding by various 3-D molecular machines including the histone based nucleosomes that "package" the strings of nucleotides in ways that may strongly affect their expression. Many other proteins bind to specific sequences of DNA in ways that enhance or suppress DNA expression.
4. "Mutations" evoke the notion of random changes to single base-pairs of DNA. Those variants are now known as single-nucleotide polymorphisms (or SNPs). However there are many other more sophisticated mechanisms that generate new genetic properties.
5. Epigenetics, the *persistent and heritable* modification of gene expression, do not change the genetic code itself yet affect the expression of the genes into proteins. Thus Dawkin's was flat wrong in asserting that a 'gene' determines a function. Moreover, some genes suppress the expression of others<sup>197</sup>.
6. Even if one gene created just one protein, proteins are very complex biochemicals that may provide multiple functions in multiple locations within specifically targeted cells The process is quite detailed and complex and has virtually nothing in common with the notion of "copying themselves"<sup>198</sup>.

In summary, the old mantra -- "one gene, one protein, one function" – was never true.

195 N. Federoff, "Transposable Elements, Epigenetics, and Genome Evolution." **Science**, Vol 338, 9 Nov. 2012, pp. 758-767.

196 <https://www.quantamagazine.org/one-gene-many-proteins-20160426/>

197 <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3441658/>

198 For much more explanation about the role and synthesis of proteins, see:

<https://www.ncbi.nlm.nih.gov/books/NBK26810/>

## Appendix 3: Examples of the World's Meme Resources

About the Library of Alexandria: ([article itself in Encyclopedia Britannica](#))

However, for most purposes, encyclopedias and even libraries are replaced by Wikipedia: This Wikipedia is written in English. Started in 2001, it currently contains 6,110,356 articles. Many other Wikipedias are available in other languages; some of the largest are listed below.

- More than 1,000,000 articles:
  - [Deutsch](#)
  - [Español](#)
  - [Français](#)
  - [Italiano](#)
  - [Nederlands](#)
  - [Polski](#)
  - [Português](#)
  - [Русский](#)
  - [Svenska](#)
  - [Українська](#)
  - [Tiếng Việt](#)
- More than 250,000 articles:
  - [Bahasa Indonesia](#) and [Bahasa Melayu](#)
  - [Bân-lâm-gú](#)
  - [Български](#)
  - [Català](#)
  - [Čeština](#)
  - [Dansk](#)
  - [Esperanto](#)
  - [Euskara](#)
  - [Magyar](#)
  - [Norsk Bokmål](#)
  - [Română](#)
  - [Srpski](#)
  - [Srpskohrvatski](#)
  - [Suomi](#)
  - [Türkçe](#)

Other sorts of information:

Music scores -- The world's **largest** collection of **music** scores and other **music**-related materials -- nearly 10 million items -- is found at the **Library** of Congress.

Engineering drawings of the Space Station, -- <https://history.nasa.gov/diagrams/skylab.html>

Test description of the Space station at: [https://www.nasa.gov/pdf/179225main\\_ISS\\_Poster\\_Back.pdf](https://www.nasa.gov/pdf/179225main_ISS_Poster_Back.pdf)

For example:

When fully complete, the ISS will weigh about 420,000 kilograms (925,000 pounds). This is equivalent to more than 330 automobiles. It will measure 74 meters (243 feet) long by 110 meters (361 feet) wide. This is equivalent to a football field, including the end zones. The pressurized volume will be 935 cubic meters (33,023 cubic feet), larger than a five-bedroom house. The solar array surface area will be 2,500 square meters (27,000 square feet), which is an acre of solar panels and enough to power 10 average-sized homes with 110 kilowatts of power.

And many University libraries – examples of those considered among the best are:

- Oxford - Oxford meets the needs of its students, academics and the international research community with a wide range of library services provided by more than 100 libraries, making it the largest library system in the UK.
- Harry Elkins Widener Memorial Library – Harvard University
- Cook Legal Research Library – University of Michigan
- William Oxley Thompson Memorial Library - The Ohio State University
- Linderman Library – Lehigh University
- William R. Perkins Library – Duke University
- Powell Library – University of California, Los Angeles
- Wilson Library – University of North Carolina